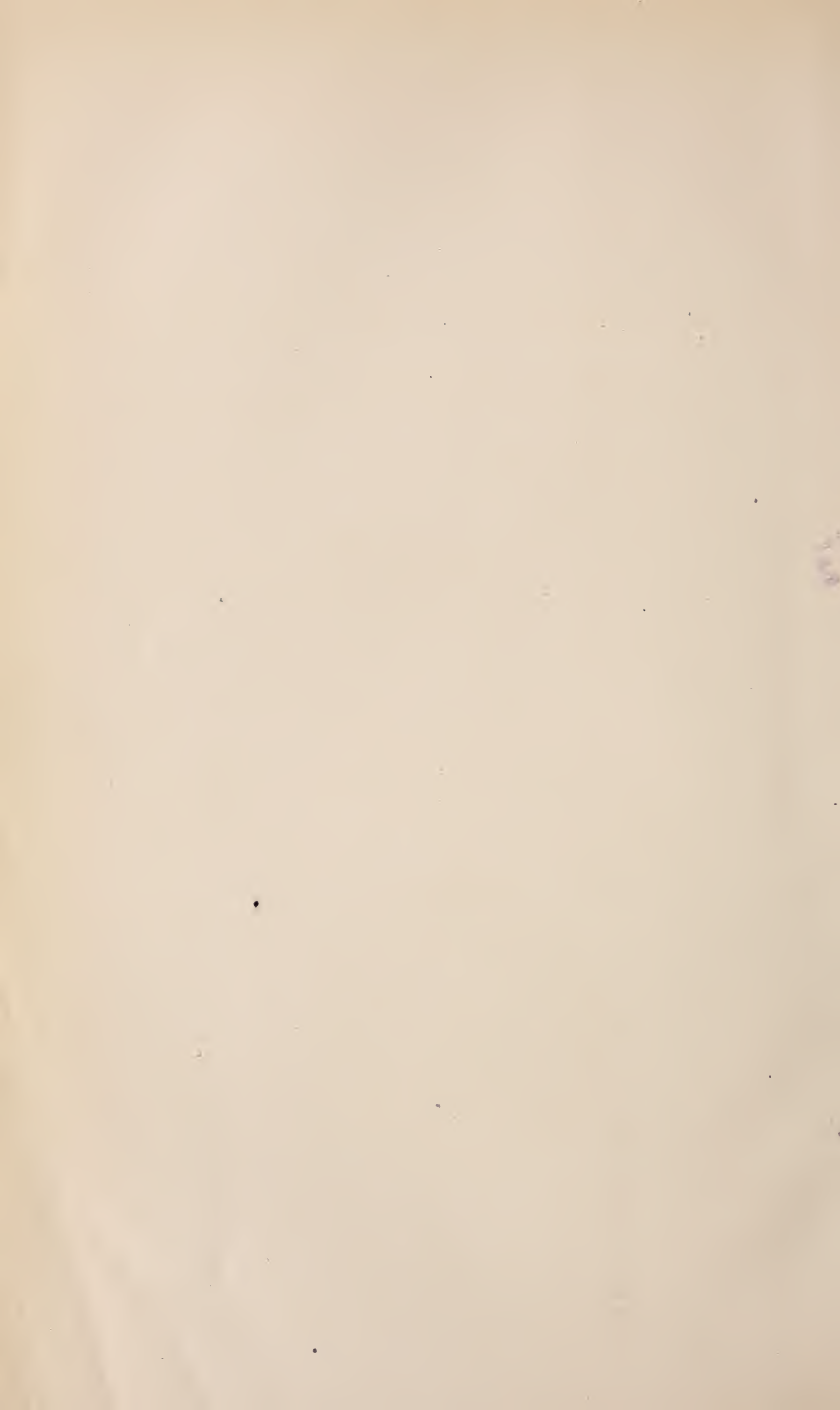


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## U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN 214.

A. C. TRUE, Director.

IRRIGATION IN THE STATE OF  
WASHINGTON.

BY

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PREPARED UNDER THE DIRECTION OF

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WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1909.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., April 10, 1909.*

SIR: I have the honor to transmit herewith a report on irrigation in Washington, prepared by O. L. Waller, professor of civil engineering in the State College of Washington. This is one of a series of reports giving the present status of irrigation in the several arid States. There is a very large call upon this Office for general information regarding the opportunities for settlement on irrigated lands in these States, the cost of land and water and of establishing homes on these lands, and the crops that may be profitably grown. The attempt has been made to include in each of these reports as nearly as possible all the information which will be needed by those contemplating settlement in the State to which it refers. It is recommended that the report be published as a bulletin of this Office.

Respectfully,

A. C. TRUE,  
*Director.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*



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## ILLUSTRATION.

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# IRRIGATION IN THE STATE OF WASHINGTON.

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## INTRODUCTION.

The progress made in irrigation development in the State of Washington has been so rapid, the capital invested so large, and the advertising by companies and promoters so extensive during the last five years that there has developed both at the experiment station and in the Office of Experiment Stations a large volume of correspondence consisting of inquiries concerning such lands. Men who want to make homes in the West are anxious to know of the conditions that obtain under the many irrigation enterprises now being opened up in the State. To meet this demand, an effort has been made to assemble in this bulletin the salient features of irrigation developments in Washington. The intent has been to compile from reliable sources and from personal observation such information as would assist an eastern farmer, a stranger to the West, in selecting a location.

To give a specific description of each enterprise and of the practice under it would extend the bulletin far beyond the limits fixed for it. But probably enough is said, in most instances at least, to inform the reader in a general way of conditions as they exist at present and to give him a basis upon which to make further inquiry.

## AREA, CHARACTER, AND VALUE OF LANDS.

The total area of the State is 69,180 square miles, with an estimated population in 1907 of 1,159,000. Of the lands 11,720 square miles is in standing timber and about 450 square miles has been logged off and cleared. About 27 per cent of the total area of the State, or 18,860 square miles (12,065,500 acres) is included in the National Forests.

The following table, taken from reports of the General Land Office, shows the area and distribution of Federal lands in the State:

*Area and distribution of Federal lands in Washington.*

Land district and county.	Area unappropriated and unsurveyed.			Brief description of character of unappropriated and unsurveyed lands.
	Surveyed.	Unsurveyed.	Total.	
North Yakima:	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	
Benton .....	33,839	.....	33,839	
Douglas .....	40,830	19,760	60,590	Rolling prairie; hilly; grazing.
Kittitas .....	170,268	310,856	481,124	Grazing; prairie; hilly; timber.
Yakima .....	176,311	297,460	473,771	Grazing; prairie and timber.
Olympia:				
Chehalis .....	2,272	.....	2,272	Mountainous; timbered land.
Jefferson .....	1,622	.....	1,622	Do.
King .....	7,640	83,150	90,790	Do.
Kitsap .....	401	.....	401	Do.
Lewis .....	440	.....	440	Do.
Mason .....	6,653	640	7,293	Do.
Pacific .....	1,080	.....	1,080	Do.
Pierce .....	1,497	.....	1,497	Do.
Thurston .....	693	.....	693	Do.
Seattle:				
Clallam .....	12,977	.....	12,977	Mountainous and broken; good supply of excellent timber.
Jefferson .....	723	.....	723	Broken and mountainous.
King .....	2,777	11,680	14,457	Do.
San Juan .....	3,084	.....	3,084	Broken; little timber.
Skagit .....	25,581	26,000	51,581	Broken; heavily timbered and mountainous.
Snohomish .....	1,080	12,880	13,960	Do.
Whatcom .....	8,875	43,080	51,955	Do.
Spokane:				
Adams .....	786	.....	786	Arid lands, valuable for grain and fruit.
Douglas .....	.....	1,500	1,500	Arid lands.
Ferry .....	117,062	501,683	618,745	Farming; grazing; timber; mineral.
Lincoln .....	43,532	4,448	47,980	Farming and grazing.
Okanogan .....	20,914	114,756	135,670	Farming, grazing, and mineral.
Spokane .....	20,481	3,094	23,575	Do.
Stevens .....	492,143	745,568	1,237,711	Mountainous; farming; mineral.
Whitman .....	3,823	.....	3,823	Grazing lands.
Vancouver:				
Clarke .....	12,922	.....	12,922	Timbered and agricultural.
Cowlitz .....	6,302	9,280	15,582	Do.
Klickitat .....	13,703	35,023	48,726	Do.
Lewis .....	12,440	.....	12,440	Do.
Pacific .....	59,126	.....	59,126	Do.
Skamania .....	65,853	34,291	100,144	Do.
Wahkiakum .....	1,351	.....	1,351	Do.
Walla Walla:				
Adams .....	22,858	.....	22,858	Prairie; farming; grazing.
Asotin .....	137,276	13,293	150,569	Mountainous; some timber and prairie.
Benton .....	43,941	.....	43,941	Desert; grazing; some timber and prairie.
Columbia .....	7,021	166,458	173,479	Mountainous; some timber and prairie.
Franklin .....	64,569	.....	64,569	Prairie and grazing land.
Garfield .....	9,774	75,108	84,882	Farming, grazing, and timber.
Klickitat .....	97,231	.....	97,231	Grazing and farming; some timber.
Walla Walla .....	8,443	.....	8,443	Do.
Whitman .....	10,850	.....	10,850	Prairie; farming and grazing.
Waterville:				
Chelan .....	350,204	96,700	446,904	Mountainous; timber and farming.
Douglas .....	528,815	172,926	701,741	Prairie; farming and grazing.
Kittitas .....	1,465	.....	1,465	Mountainous; timber and farming.
Okanogan .....	470,682	359,172	829,854	Do.
State, total...	3,122,210	3,138,806	6,261,016	

The total assessed valuation of real and personal property, including railroad tracks, for 1890 and the several years since 1900 (1907 omitted) was as follows:

1890 .....	\$217,612,897	1904 .....	\$298,460,979
1900 .....	237,576,523	1905 .....	328,542,525
1901 .....	260,180,734	1906 .....	530,209,882
1902 .....	260,940,138	1908 .....	784,000,000
1903 .....	276,988,569		

These figures also show the rapid growth of the State, especially for the last few years.

The Cascade Mountains, extending in a broken range from north to south across the State and about 140 miles east of the coast, in a general way divide the State into what is known as "East and West sides."

The great territory west of the Cascades and extending well down on the east slope is heavily timbered, except along the streams and in the more accessible places, where the timber has been cut and manufactured. Over this territory the rainfall is abundant, the rugged mountains are capped with snow, the vegetation is rank, and the great forests, consisting of giant firs, cedars, hemlocks, and spruces, are unsurpassed. East of this timber belt and in the foothills on the less elevated portions of the eastern slopes of the Cascades is a strip of rough, rugged land, fairly well watered from winter snows and by mountain rains, which affords good grazing for cattle and sheep.

The arid belt extends from the eastern foothills of the Cascade Mountains to some distance east of the Columbia and Okanogan rivers. These arid, treeless lands are generally covered with a rank growth of sagebrush. East of this arid strip is the great wheat-producing belt, extending to the Idaho line. Formerly much of this land was a bunch-grass range and was considered unfit for the production of crops; yet the "wheat belt" in 1907 produced more than 51,000,000 bushels of cereals and in 1908 more than 60,000,000 bushels.

The general topographical features of the State and the location of railways are shown on Plate I.

Since the publication of the commissioners' report, from which the location of the railways is taken, much of the work on some of the proposed lines has been done and for others heavy property purchases have been made. It is probable, therefore, that all the track-age shown on this map, with possible minor changes in location, will be built and in operation within the next year or two.

## RAILROADS.

### EXISTING ROADS.

The railroads in full operation at the time of this report are the Great Northern, crossing the State from Spokane to Seattle and Bellingham; the Northern Pacific, extending from Spokane through the Yakima Basin to Tacoma, Seattle, Bellingham, Grays Harbor, and Portland, with branches to the Big Bend country and to Lewiston, Idaho; and the Oregon Railroad and Navigation Company's road from Portland through the wheat belt to Spokane.

**EXTENSIONS AND PROJECTED ROADS.****THE PORTLAND AND SEATTLE.**

This road, sometimes called the North Bank road, is now running a regular schedule of trains from Pasco to Vancouver, a distance of 221 miles, while the grade from Pasco along the north bank of the Snake River to Texas City, about 75 miles by air line, is about completed. This road is owned jointly by the Great Northern and the Northern Pacific systems. This new road will furnish a water grade to the ocean for heavy freight that otherwise would have to be hauled over the Cascade Mountains to the Sound shipping points. It will be an important factor in marketing the heavy cereal crop of the Inland Empire and incidentally supply transportation for the heavy stock raisers of the southern parts of Benton and Klickitat counties.

**CHICAGO, MILWAUKEE AND ST. PAUL RAILROAD.**

This road has a proposed extension from Butte, Mont., to Tacoma and Seattle. In general the grading and many of the structures are completed.

**NORTH COAST RAILROAD.**

The surveys for this road are generally completed, franchises secured, and terminal grounds purchased. While the identity of its financial backers has not been made known, the work so far accomplished and the expenditures made are a pretty good guaranty that the road will be built. It traverses some of the best counties of the State and will greatly improve their transportation facilities.

**OREGON AND WASHINGTON RAILROAD.**

This road is really an extension of the Union Pacific system. In general it parallels the Northern Pacific from Portland to Tacoma and Seattle. It is now open and operating a train schedule.

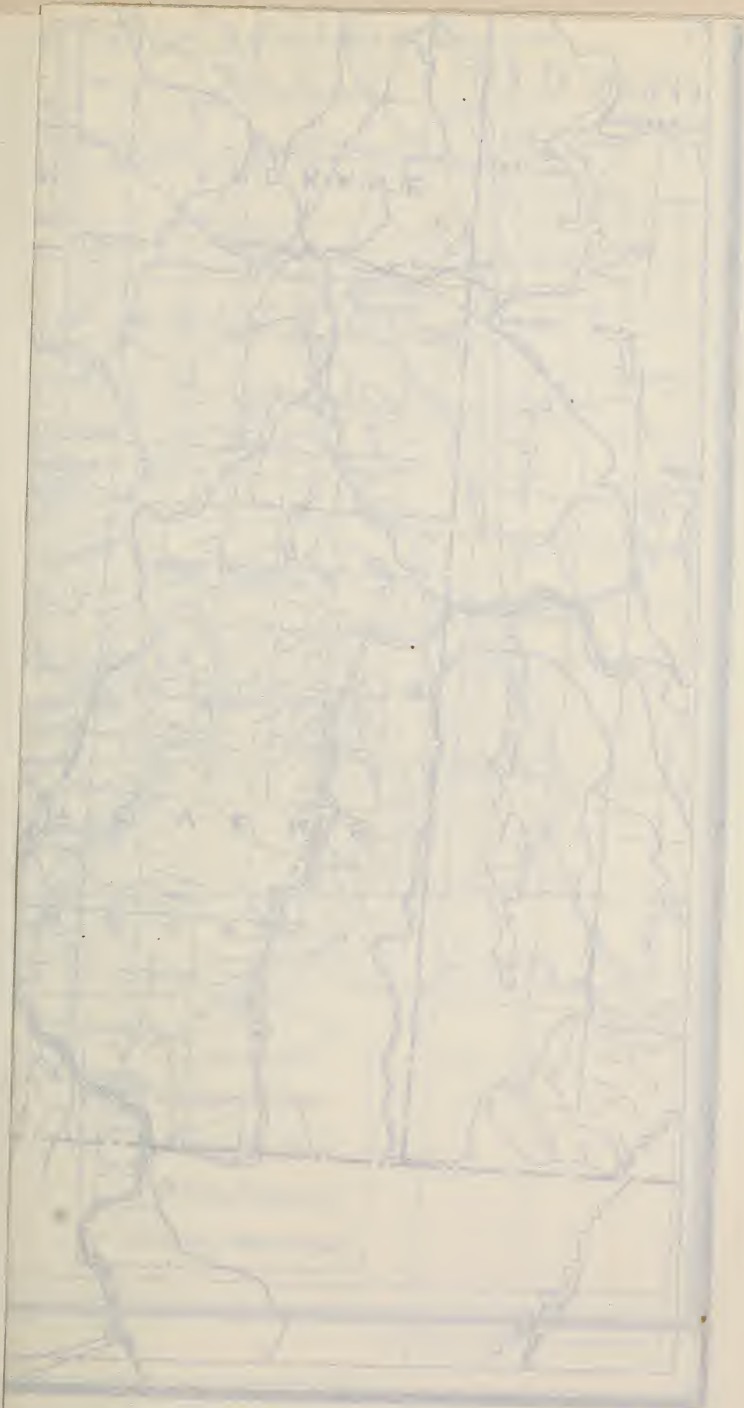
**SPOKANE AND INTERNATIONAL.**

This road, in conjunction with the Canadian Pacific and the "Soo Line," has been operating 140 miles of road for many months.

**ELECTRIC LINES.**

Since the original of the attached map was published the inter-urban electric lines have extended their systems considerably. There is so much undeveloped water power in the State that can be harnessed at reasonable cost that rapid extensions of electric lines into the farming and fruit-growing districts are confidently expected.







## WATER TRANSPORTATION.

### PUGET SOUND.

Puget Sound, with its many ramifications, is a great inland sea, used by the greatest ocean liners and war ships, as well as by the small coast steamers. The latter pick up and carry produce to the great shipping centers, where ocean-going vessels load for the markets of the world.

### COLUMBIA RIVER.

The Columbia River is navigable for most of the 959 miles of its course across the eastern part of the State and along its southern boundary. Ocean steamers load and discharge freight and passengers at Portland, on the Willamette, and steamboats make regular runs from Portland to The Dalles. There is a daily steamboat service from Pasco to Priest Rapids and from Wenatchee to Bridgeport; also on the Snake River from Riparia to Lewiston, Idaho, and on the Okanogan River from Brewster to Riverside, except during the low stage of the river. An irregular service is maintained also at some other places on the Columbia. There are several rapids and falls that obstruct the free navigation of the Columbia. Some of these have been removed and the work of providing a waterway from the ocean to beyond the British Columbia line is progressing steadily though slowly. Doubtless much of the grain and heavy freight now going by rail will then be carried in river boats to tide water. With a moderate expense the Snake River could be cleared of rocks below Riparia and the way thus opened from Lewiston, Idaho, to the ocean, adding another 137 miles of open river and affording improved transportation to a rich farming country.

### RIVERS.

West of Puget Sound are the Olympic Mountains, with snow-capped peaks and heavy precipitation (100 inches per year), which feed many small streams and rivers. Most of this territory is within the National Forests. Some of the streams fall several thousand feet in their rush to the ocean, affording many opportunities for power development.

The streams winding their courses westward from the Cascade Range through a jungle of forest and undergrowth furnish very many power sites. At some seasons of the year these rivers are torrents, and at all times they carry large volumes of water. Already the great falls of some of them have been put under control and supply light and power to the coast cities and interurban electric railways. The development, however, has only commenced.





MAP OF THE STATE OF WASHINGTON SHOWING STREAMS AVAILABLE FOR IRRIGATION





East of the Cascades and fed by the great snow fields of these mountains are the Okanogan, Methow, Chelan, Entiat, Wenatche, and Yakima rivers, supplying power and water to irrigate the thirsty sagebrush desert through which they flow. Most of the irrigated area of the State is watered by these streams. A part of this region, however, is watered from the Columbia River by pumping, and farther east some semiarid lands are irrigated from the Colville and Spokane rivers, drawing their supply from the Bitter Root and Coeur d'Alene mountains.

In southeastern Washington the Walla Walla and Touchet rivers and Mill Creek, together with their feeders from the Blue Mountains, irrigate a considerable acreage about Walla Walla, Wash., and Milton, Oreg.

The Snake River, with its abundant supply of water, crosses the southeastern part of the State in a canyon for most of the distance. However, nearly all the bars along its course are irrigated either by pumps or from small streams falling into the river. The Benton Water Company has asked Congress for a permit to dam the Snake River at Five Mile Rapids, near its mouth, for the purpose of developing power to pump water onto a large body of valuable lands in and around Pasco.

### **POWER RESOURCES.**

The State of Washington is particularly fortunate in having millions of horsepower of undeveloped energy in her streams. With the Olympic Mountains west of the Sound, the Cascades extending from north to south across the State, the Blue Mountains in the southeastern part of the State, and the Bitter Root and Rocky mountains on the east furnishing lofty watersheds covered with perpetual snows, the power of streams of the State is destined to add very considerably to its material growth.

### **COLUMBIA RIVER.**

The Columbia River, with its many large tributaries from Montana, Idaho, and British Columbia, draining an area of 250,000 square miles, and drawing its supply from the snow fields of great mountain ranges, affords large possibilities for power developments. The annual minimum flow above Kettle Falls is reported as ranging from 19,000 to 30,000 cubic feet per second. This is a run-off from a drainage area of 63,160 square miles, of which 10,000 to 12,000 square miles is lake surface. At Kettle Falls the drop is 37.5 feet over a dike of rock, making a dam and power development extremely simple. With some storage the energy of these falls may be safely rated at 100,000 horsepower.

At Rock Island there is a fall of 72.5 feet in 8,000 feet, and a minimum discharge ranging from 23,000 to 34,000 cubic feet per second. The energy now wasted at this point amounts to 190,000 horsepower.

At Cabinet Rapids the fall is 10 feet in 8,000 feet, and the energy equals 26,000 horsepower. At Priest Rapids the fall is 72 feet in 10 miles, and the energy of the stream is 188,000 horsepower.

In the section known as the Grand Dalles, which includes the Cascades at Celilo, Ten Mile Rapids, The Dalles, Three Mile Rapids, and Two Mile Rapids, the fall is 80 feet, 20 feet of which is a sheer fall at Celilo. The minimum flow is rated at 26,000 to 37,000 cubic feet per second and the minimum energy of the stream is 236,000 horsepower, of which the sheer fall at Celilo makes 60,000 horsepower. At the Cascades the fall is 24 feet in 3,000 feet and the minimum energy of the stream is 71,000 horsepower.

Besides the large falls and cascades referred to, there are many others from Kettle Falls on down to Rock Island. While the Snake River has much swift water, the removal of dangerous rocks would make it navigable from its mouth to some distance above Lewiston, Idaho, and consequently it does not afford many promising power sites.

#### **SPOKANE RIVER.**

The power in the Spokane River has already been developed in several places, namely, Post Falls, the city pumping station at the series of rapids and falls at Spokane, at a point 9 miles below Spokane, and at a point opposite Reardan. In all 100,000 horsepower has been developed. Some of this acts directly on the turbines of the city pumping plants or of flour, feed, and saw mills. The greater part, however, is converted into electricity at high voltage and transmitted long distances for light and power. In general, nearly all the light and power used in the State, with the exception of that developed by the lumber industries, which burn slabs, edgings, sawdust, etc., is supplied from hydro-electric developments. Most of the towns and cities in the "Inland Empire" are supplied with light and power from the Spokane River, while interurban railways supplied with power from the same source are rapidly threading the rich wheat and produce belt of Washington and Idaho.

#### **METHOW RIVER.**

The fall of the Methow River is about 25 feet per mile, with a minimum discharge of 400 cubic feet per second. Along its course from Twisp to its mouth there are many fine power sites where dams could be thrown across the river and economical development be made.

### POWER AT LAKE CHELAN.

The minimum of flow from Lake Chelan is about 812 cubic feet per second, the fall 360 feet, and the energy about 33,000 horsepower. The development here will be simple and quite inexpensive. If the lake storage were used to equalize the flow, the above could be very greatly increased.

### POWER FROM THE WENATCHE RIVER.

The minimum flow of the Wenatche River is about 850 cubic feet per second, only about 25 per cent of which is used for irrigation purposes, and that only in the lower valley. For 14 miles through the Tumwater Canyon and before emerging into the agricultural valleys this stream is a raging torrent. The Great Northern Railroad Company has nearly completed a power plant at Chiwaukum, in the Tumwater Canyon, where it will develop 10,000 horsepower with which to operate trains through the Cascade tunnel. There are yet great undeveloped power possibilities along the river, probably more than can be utilized for many years to come.

### POWER OF YAKIMA RIVER.

Since much of the water now used and much of the stored water later to be used in the Yakima Valley will be distributed to lands pretty well down the valley, it will be possible to develop a very considerable amount of power from the water before it reaches the agricultural lands upon which it is to be used finally, and there is great need for such power for use in domestic industries and to be distributed over the densely populated irrigated districts for light and power.

### POWER OF OTHER STREAMS.

There still remain opportunities to develop power along the lower Colville River, some of which are now in use.

For want of reliable data upon which to base estimates, very many important streams, particularly west of the Cascades, must be omitted from the report. However, large power installations have been made along some of them, as referred to in other parts of this report.

### TIMBER INDUSTRIES.

The State in 1907 had about 195,658,080,000 feet board measure of standing timber. There were 535 sawmills, with an annual capacity of 5,105,925,000 board feet, and 417 shingle mills, with an annual capacity of 8,352,750,000 pieces. Consequently lumber, shingles, and wood products of various kinds constitute the chief of Washington's manufactured products. Besides the lumber and shingle mills, there are a large number of sash and door factories and other concerns manufacturing a variety of commodities from wood. Some idea of

the extent of the lumber business in the State may be had from the pay roll distributed among the loggers and lumbermen alone. It approximates \$65,000,000 annually.

The following table, prepared by Victor H. Beckman, secretary of the Pacific Coast Lumber Manufacturers' Association, gives some valuable data on timber acreages and quantities:

*Distribution of the timbered area by counties and the acreage thus far cleared.*

County.	Acres timbered.	Acres cleared.	County.	Acres timbered.	Acres cleared.
Chehalis .....	803, 151	8, 316	Skamania .....	138, 085	2, 369
Clallam .....	413, 376	4, 693	Skagit .....	406, 703	35, 655
Clarke .....	356, 405	37, 609	Snohomish .....	520, 034	19, 673
Cowlitz .....	440, 403	26, 648	Thurston .....	401, 177	9, 829
Jefferson .....	204, 277	2, 663	Wahkiakum .....	130, 502	2, 604
King .....	726, 572	39, 564	Whatcom .....	316, 350	32, 307
Kitsap .....	214, 007	4, 773	Island .....	107, 254	2, 007
Lewis .....	787, 314	24, 110	San Juan .....	100, 558	3, 440
Mason .....	377, 709	2, 754			
Pacific .....	448, 802	2, 800	Total .....	7, 495, 586	286, 728
Pierce .....	602, 907	22, 384			

### CEREAL PRODUCTS.

The estimated wheat yield for 1907 was 40,845,000 bushels; oats, 5,425,000 bushels; barley, 4,940,000 bushels, making a total of 51,210,000 bushels. Most of this came from the great wheat belt in eastern Washington. Some fine oats, however, are raised in western Washington. Probably 75 per cent of these crops is milled at home. There are about 60 mills in the State turning out flour and feed, and a number of breakfast-food, cracker, and biscuit factories. After supplying the local demand, the balance of the unground grain, flour and feed, and manufactured foodstuffs finds a market in foreign countries.

### CREAMERIES.

In 1906 there were 284 creameries in the State, which manufactured 8,473,612 pounds of butter. The best dairy regions of the State are found west of the Cascade Mountains, where grass grows very luxuriantly, and in such of the irrigated regions as are principally devoted to alfalfa raising. Dairying is very profitable at Ellensburg and Sunnyside, and at some other places creameries are being installed. The industry is profitable and there are great opportunities for future development.

### COAL MINING.

There was taken from the coal mines of the State in 1907, 3,680,532 short tons of coal, having a spot value of \$7,679,801. There were 5,945 men employed in the mines, who worked an average of two hundred and seventy-three days. The coal beds are found in the western and central portions of the State, and are mined in five principal fields—the North Puget Sound fields, including the coal mines of



Skagit and Whatcom counties; the South Puget Sound fields, comprising the mines in King and Pierce counties; the Puget Sound Basin east of Seattle; the Roslyn field, in Kittitas County on the eastern slope of the Cascade Mountains; and the southwestern field, embracing the counties of Lewis and Cowlitz.

The coals of Washington range from lignite to bituminous coking, and include some natural coke and anthracite. These are the only bituminous coking coals found on the Pacific coast, the Wilkinson-Carbonado district supplying all the coke used in the Northwest.

### CLIMATE ABOUT PUGET SOUND.

From a study of the U. S. Weather Bureau reports it may be seen that the climate of Puget Sound suffers no very sudden changes. It is never extremely cold nor extremely hot. It is always tempered by ocean breezes. The average summer temperature is 60° F.; the average winter temperature, 44° F.; while the average for the year is 51.5° F. The temperature in winter rarely drops to freezing point.

The average rainfall may best be understood by comparing it with that of other localities. The following table gives the average rainfall for various cities of the United States:

*Rainfall at various cities of the United States.*

City.	Rainfall.	City.	Rainfall.
	<i>Inches.</i>		<i>Inches.</i>
New York.....	41.8	Neah Bay, Wash.....	100.0
Mobile.....	91.8	St. Paul, Minn.....	34.3
Seattle.....	36.4	Indianapolis, Ind.....	38.4
Astoria, Oreg.....	76.0	Everett, Wash.....	36.9
Eureka, Cal.....	45.0	Western Snohomish points.....	36.4

### SOIL OF CENTRAL WASHINGTON.

The soil throughout central Washington is deep and rich and, with a few exceptions, is fit for agriculture. Owing to the light rainfall and the wide sagebrush plains, the general appearance of the country is barren and sterile; yet where irrigation is practiced the crops are unusually large. Hay, alfalfa, wheat, oats, potatoes, hops, fruits, and vegetables of all kinds are raised in abundance. The weeks and months of uninterrupted sunshine during the long, hot summers admit of an almost tropical luxuriance of growth wherever the necessary amount of moisture is supplied.

Following the flow of the Columbia lava, central and eastern Washington, as well as some parts of Idaho and northern Oregon, were covered by a lake known as Lake John Day, into which streams washed mud and sand, and volcanoes in time of violent eruption strewed vast quantities of fine white dust and lapilli. That these lake deposits were continued for a very long period of time is made evident by the great depth of the formation.

At a later date the Columbia lava and the superimposed lake deposits were upraised and tilted, exposing the lava in places. The sedimentary deposit has been almost entirely washed away, leaving the lava as the surface rock. These lake deposits are usually light colored, unconsolidated sediment, and in places, as at White Bluffs, readily crumble to sand and clay between the fingers.

That all the irrigated districts and all the great wheat belt of Washington were parts of a great lake bottom, made up of disintegrated basaltic rocks and volcanic dust, accounts for their very great fertility.

### HISTORY OF IRRIGATION IN WASHINGTON.

If a complete history of irrigation in Washington were undertaken, it should contain the abstracts of water filings, which of themselves would make quite a volume. In a very large number of instances the filings plainly show that the appropriator had a very uncertain conception of the amount of water required to irrigate his land. As he was registering a claim for a public commodity which the State was anxious to give away, he spent very little time thinking of his future neighbors or of the thirsty lands that lay all about him, but laid claim in many instances to all the water in the stream. The abstracts must be omitted here, but they show that irrigation was practiced along the small streams as early at least as the sixties, and likely by individual farmers earlier than that. The first ditches were little more than plow furrows leading the water to the small farms, which were generally seeded to grass to supply winter feed for stock. Later, a few farmers would organize a stock company and construct a more pretentious ditch, each taking water in proportion to the number of shares held. The diversion works generally consisted of simple headworks and some kind of a wing dam to divert the water. On these early irrigated farms grass was the chief staple, orchards being planted only for domestic purposes. Only within the last few years, since the great transportation companies have entered the State and the people have learned to market their fruit, have irrigated lands been much devoted to orchards.

After the lands easily watered from the small streams had been filed on, corporations began to look with favor upon higher bench lands and to construct larger and higher canals and to sell lands and water rights. Following this came a period of power development for the purpose of pumping water onto small benches and bars remote from a gravity supply. These power plants range from small gas-engine installations to the great hydro-electric plant at Priest Rapids. These power installations are likely to be rapidly increased until the extreme height to which water may profitably be raised for irrigation purposes is reached.

Most of the lands now irrigated are in proximity to streams, large or small, having their sources in the high mountainous lands and falling rapidly to their outlet. In such cases reasonably short ditches convey the water to the lands to be irrigated. Along the Columbia, Snake, and Okanogan rivers, where the fall is slight, the same conditions as to bars, valleys, and upland benches are to be found. But here, on account of the slight fall in the stream, it is generally impossible to divert water in ditches and carry it onto the lands to be irrigated.

There are a great number of gas and oil engine pumping plants now lifting water from the Columbia River onto most of the lower bars and benches. These plants range all the way from 10-horsepower outfits, lifting about 30 feet, to 250-horsepower installations, working against a 250-foot head. With the coming of power developments along the Columbia, probably most of the new installations and many of the older ones will use electricity.

Truck gardening and fruit raising have reached large proportions. A large and growing acreage is planted or being planted to orchards. Prices of fruit and garden stuff are high and the business is attractive—so much so that most of the irrigated land now being marketed is sold for fruit land and a higher price is secured for it.

There are yet many thousands of acres of higher lands that can be covered by high-line ditches that are well away from frost drainage and that will make splendid orchard lands. The cost of watering such lands, on account of long, tortuous canals, will generally be high, yet with the possibility of placing fruit products on all the markets of the world, the opening up of such lands will not be delayed many years.

## **CROPS ON THE IRRIGATED TRACTS.**

### **FRUITS.**

For so young an industry fruit raising is rapidly assuming large proportions. The fruits generally raised are peaches, pears, apricots, nectarines, apples, grapes, cherries, and berries, depending somewhat upon the locality. Apples of the best quality and flavor come generally from the higher valleys, as some parts of the Yakima, Wenatche, the Vale of Cashmere, and the upper part of the Methow and Colville valleys. Peaches, apricots, nectarines, and grapes yield abundantly at the lower levels along the Columbia and Snake rivers, where the season is early and the temperature high. Even here such fruits should be planted well out of the way of frost drainage, unless smudging is to be resorted to.

Apples easily lead the list in the magnitude of the orchards and the extent of their distribution. The small fruits are extensively and profitably grown, but the gross returns from winter apples easily outstrip them all. A long growing season, fertile soil, plenty of



moisture, and abundant sunshine conspire to mature the apple, to give it size and a fine flavor, and to intensify its coloring.

The following statements, showing in a general way the distribution of fruits raised, the yields, and the market prices, are authoritative and can be relied upon. A considerable number of them are tabulated from the affidavits of the parties raising the crops. These statements were secured from men who give their orchards careful attention and in return get the best results. There are plenty of growers who do not do nearly so well. True, their lands may not be quite so favorably located, but generally a tree, like an animal, responds to care, and where good husbandry and a knowledge of the business are found the yields are satisfactory.

The following table gives some of the yields and values of fruits in the Yakima Valley near North Yakima:

*Yield and value of fruits in Yakima Valley.*

Name of grower.	Kind of fruit.	Area.	Number of trees.	Age of trees.	Amount of crop.	Receipts per acre.
		<i>Acres.</i>		<i>Years.</i>	<i>Boxes.</i>	
W. F. F. Selleck.....	Peaches	2.04	275	3	3,200	\$1,122
J. Van Peyton.....	do	2.16	290	3	4,133	1,430
C. Q. Scoboria.....	do	3.00	450	3	4,000	1,000
E. F. Perry.....	do	2.40	325	3	4,900	1,536
C. S. Huff.....	do	1.20	159	3	1,875	1,250
W. H. Strausz.....	do	.90	122	5-6	2,560	2,133
A. H. Henry.....	do	.20	23	7	480	a381
A. E. Glenn.....	do	4.00	448	3-5	2,900	529
C. O. Shupe.....	do	.12	14	7	305	a228
Wm. Miller.....	do	.20	28	5	607	a453
J. P. Bullan.....	do	.50	65	4-5	1,235	-----
S. W. C. Hand.....	do	2.20	275	3-6	3,000	1,002
Alex Burnham.....	do	2.50	307	5	8,611	2,580
W. M. Nelson.....	do	.75	100	2	500	a375
C. S. Druse.....	do	-----	18	2	180	a135
W. I. Huxtable.....	do	12.00	-----	3-4	-----	1,830
H. M. Gilbert.....	All kinds	18.00	-----	8-9	8,732	1,071
J. Van Peyton.....	Berries	.16	-----	-----	140	a240
W. I. Huxtable.....	do	3.50	-----	-----	-----	570
W. L. Gale.....	Apples	15.00	1,200	8-12	6,000	666
Do.....	Pears	.50	60	8	300	a375
Do.....	Cherries	-----	15	8	b4,000	a240
W. P. Sawyer.....	Pears	5.50	616	13	4,620	1,524
E. M. Roseland.....	Apples	6.00	400	7	1,400	440
R. D. Herod.....	do	5.00	200	4	100	40
Do.....	Peaches	1.50	150	4	1,100	400
E. W. Brackett.....	Apples	1.75	170	12	1,020	1,203
Do.....	Cherries	.10	10	12	-----	a135
A. T. Richardson.....	Peaches	4.00	457	3	3,217	941
Thekla Wiesberger.....	do	3.50	340	5	5,600	1,280
W. N. Irish.....	do	.50	65	3	880	a668
Do.....	Apples	1.10	120	11	510	1,057
W. H. Strausz.....	Peaches	-----	122	5-6	2,560	a1,910
Granville Lowther.....	do	-----	40	13	1,301	a976
Geo. La Bissionnerre.....	Cherries	.20	20	9-12	-----	a650
Do.....	Pears	.30	50	10-12	-----	a300
John Hasselstrom.....	Apples	1.00	84	5	70	140
H. R. Linse.....	Peaches	.60	70	3-5	1,250	a950
M. W. Pennington.....	Pears	9.00	865	10	2,200	500
W. L. Wright.....	All kinds	18.00	1,665	12	11,000	605
Osborn Russell.....	Apples	-----	-----	-----	1,600	2,300
C. O. Shupe.....	do	1.25	137	7	743	888
J. W. Durham.....	do	.75	60	6	624	a1,065
I. E. Waggoner.....	do	6.00	325	5	1,175	300
J. H. Forman.....	do	1.50	140	10	800	800
Do.....	Pears	.50	54	16	883	a3,650
S. G. Moore.....	Apples	.50	60	7	600	a1,200
H. H. Green.....	Grapes	1.25	600	3	3,170	760
C. C. McWhorter.....	do	.50	-----	3	c1,000	a200
H. C. Haney.....	Onions	2.50	-----	-----	-----	400
Carl Schrien.....	Hay	60.00	-----	-----	-----	107
Everett Cleveland.....	Potatoes	3.00	-----	-----	a73.5	385

a Total return from field less than 1 acre.

b Pounds.

c Baskets.

d Tons.

The Wenatchee Valley is extensively advertised as "The home of the big red apple," and the name has been well earned, as facts compiled from the 1907 report of Prof. F. A. Huntly, commissioner of horticulture of Washington, show.

*Proportions of different kinds of fruits shipped out of Chelan County in 1907.*

Kind of fruit.	Cars.	Boxes.	Value.	Kind of fruit.	Cars.	Boxes.	Value.
Apples.....	616	369,600	\$646,800	Berries.....	12	8,500	\$21,250
Pears.....	45	29,250	32,175	Apricots.....	29	20,300	15,225
Peaches.....	301	301,000	225,750	Melons and vegetables.....	221	154,700	75,000
Cherries.....	10	12,000	10,800	Total.....	1,302	942,950	1,056,400
Plums.....	65	45,500	27,300				
Grapes.....	3	2,100	2,100				

*Fruit canned by the Wenatchee Canning Company.*

Kind of fruit.	Gallons.	Quarts.	Kind of fruit.	Gallons.	Quarts.
Peaches.....	36,000	64,000	Apricots.....	3,500	4,500
Prunes.....	14,000	.....	Apples.....	30,000	.....
Pears.....	7,000	.....	Total.....	90,500	68,500

These figures were gathered from the railroad shipping reports and checked up by the reports of the box factories, estimates of the large shippers, and various other sources of information.

Mr. W. T. Clark, president of the Wenatchee Canal Company, who has had unusual opportunities to observe the progress of the development of the valley, estimates that in and about Wenatche there are 10,000 acres in orchards, of which 6,000 acres are in bearing or planted to trees that are 6 years old or more, 1,500 acres of 5-year-old orchard, and 4,500 acres under 5 years old.

Mr. D. M. Tibbits, president of the Wenatchee Valley Fruit Growers' Association, estimates that there are 1,000 acres in orchards on Peshastin Creek, 200 of which are in bearing. There are likely a few hundred acres of young orchards scattered in other places in the valley. The writer drove more than 30 miles through the valley and on to the best observation points and all the time was in a wilderness of orchards, the greater part of which were young, less than 5 years old. Everywhere this valley showed careful cultivation, proving that the people were thrifty, had caught the spirit of progress, and were really making the most out of their opportunities.

William Turner planted 18 acres of apples in 1901 and 14 acres more in 1902. In 1903 he planted strawberries between the rows to help make expenses while the orchard was growing. In 1907 the crop, largely from the first 18 acres planted, was as follows, giving the list of the varieties sold and the amount received.

*Apples sold by William Turner in 1907.*

Variety.	Boxes.	Value.	Variety.	Boxes.	Value.
Jonathan .....	3,083	\$6,293.85	Banana.....	108	\$216.00
Winesap .....	3,879	8,985.95	Gano .....	55	99.00
Arkansas Black.....	208	468.00	Rome Beauty .....	804	1,405.50
Stayman Winesap .....	634	1,106.25	Total .....	8,872	18,717.35
Ben Davis.....	7	11.20			
Black Twig .....	94	131.60			

There were yet unsold 191 boxes, besides some in the cellar (amount not given).

W. M. Little, from 4 acres of 7-year-old orchard in 1907, picked 2,028 boxes of Winesap apples and 75 boxes of summer fruit, which netted him \$4,451.

Charles B. Reed says:

My pear trees are 1 rod apart, or 160 trees to the acre; the pear trees have yielded an average of 10 boxes per tree each year for the last three years (1903, 1904, and 1905); the net price received in 1903 was 85 cents per box, or \$8.50 per tree; in 1904, 75 cents per box, or \$7.50 per tree; in 1905, 95 cents per box, or \$9.50 per tree—a total for three years of \$8.50, \$7.50, and \$9.50, or an average of \$8.50 per tree, or at the rate of \$1,360 net per acre per year.

The following tabulation will show some of the yields and returns for 1907:

*Yields and returns in 1907 from fruits in Washington.*

Name.	Kind of fruit.	Area.	Number of trees.	Age.	Boxes.	Receipts.	Receipts per acre.
		<i>Acres.</i>					
Jay Jones.....	Peaches .....	1.50	200	7	3,500	\$2,625	\$1,750
J. H. Blake.....	Apples .....	.93	100	8	1,039	2,367	2,556
H. A. Saunders.....	Prunes .....	3.39	464	13	3,800	1,900	561
W. E. Wishnand .....	do .....	1.75	200	4	2,508	1,881	1,075
William Tedford.....	do .....	.25	20	3	175	131	.....
Jo. Kelner.....	do .....	.75	88	7	1,200	900	1,200
Michael Daly.....	do .....	4.50	600	2	1,200	900	200
H. L. Tedford .....	Apricots, peaches, apples.	11.00	.....	6	6,400	6,150	559
Elsworth France .....	{Peaches .....	.012	16	6-7	400	300	.....
	{Apricots .....	.01	12	6	169	153	.....
Alex. Murray.....	{Peaches, cherries, apples.	5.50	622	5-6	2,780	3,131	569
Hardman Bros. & Manning..	{Cherries .....	.....	10	10	300	293	.....
	{Peaches .....	.50	50	10	500	400	.....
	{Apples .....	11.00	880	10	5,555	6,399	582
L. V. Wells.....	{Cherries .....	.10	18	14	400	400	.....
W. M. Little.....	{Apples .....	4.00	.....	6	2,103	4,942	1,235
Total .....		45.19	.....	.....	.....	32,862	.....
Average yield per acre.....			.....	.....	.....	727	.....

Mr. A. C. Jones states that the net profits of the F. H. and J. C. Fruit Ranch of less than 30 acres in the vale of Cashmere for the season of 1905 was \$6,000, or a little more, including a few fancy apples not sold at the time of making this report. This orchard was planted to apples, apricots, cherries, peaches, and pears.

At Kennewick, John Storling realized \$648 from 2.5 acres of strawberries in 1907; James A. Rose received \$465 from a single acre of strawberries in 1905; E. Bennett in 1907 sold \$149 worth of grapes from 100 4-year-old grape vines; and W. S. Haxton took \$700 worth of European grapes from one-half acre of ground. Mr. E. L. Stewart, of Prosser, president of the Washington Horticultural Association, makes the statement, dated November 26, 1907, that he sold from 6 acres of 11-year-old apple trees 7,361 bushels, receiving a gross price of \$6,228.90, which left him a net profit of \$4,313.75, or an average of \$719 per acre. In 1904 this orchard netted him \$400 per acre; in 1905, \$400 per acre; and in 1906, \$719 per acre.

A. B. Wheeler, of Kettle Falls, says that from a 5-year-old peach tree he picked 23 boxes of peaches in 1906, which sold for \$1 per box, and that from 10 trees he sold 110 boxes. Dr. C. B. Stayt, of the same place, gathered from 86 trees 666 boxes of cherries that were sold for \$435; 7 apricot trees yielded a return of \$63. Doctor Stayt's lands were not irrigated.

S. S. Strahorn, in the Spokane Valley, in 1908, sold 118 crates of strawberries from three-fourths of an acre, which netted him \$2 per crate; 130 crates of black-cap raspberries from 750 vines, at a net return of \$2 per crate. J. W. Hipple sold 60 crates of black-cap raspberries from one-fifth of an acre, at a net profit of \$2 per crate; 120 crates of strawberries from 2,700 square feet of land, at a net return of \$2 per crate.

Since the fruits and vegetables from all the irrigated lands generally seek the same markets, the price levels would be about the same. So, also, the cost of picking, boxing, etc., is generally uniform, so that the profits will very largely depend upon yields.

The prices of fruits and berries are quite uniform from year to year. The same may be said of the grass crops, as timothy, clover, and alfalfa. Other crops, such as potatoes, hops, melons, tomatoes, etc., fluctuate more in price and are not generally considered so safe. Sometimes the profits from these latter products are very large, and again, there may be a loss. The price on the tomatoes is generally good, but they blight seriously in many places and can hardly be counted on for a safe crop.

Mr. Robert Schleicher, of Clarkston, reports a net profit for ten years of \$300 per acre on grapes. Mr. G. W. Lancaster says his 2-acre tract of strawberries nets him about \$300 per year.

Below is given a tabulated statement, compiled from the reports of the horticultural inspectors and others.



## Statement of fruit shipments for 1906.

County.	Apples.	Pears.	Peaches.	Cherries.	Plums, prunes.	Grapes.	Berries.	Miscella- neous.
	<i>Boxes.</i>	<i>Boxes.</i>	<i>Boxes.</i>	<i>Boxes.</i>	<i>Boxes.</i>	<i>Crates.</i>	<i>Crates.</i>	<i>Packages.</i>
Benton.....	22,328	3,151	4,087	34	1,331	325	6,500	.....
Chelan.....	198,544	16,980	152,400	20,400	27,080	3,600	15,360	.....
Clarke.....	.....	.....	.....	.....	.....	.....	.....	108,000
Cowlitz.....	.....	.....	.....	.....	.....	.....	.....	8,600
Kitsap.....	19,950	3,453	.....	.....	.....	.....	4,000	.....
Klickitat.....	231	.....	567	.....	392	162	6,697	.....
Lewis.....	.....	.....	.....	.....	.....	.....	1,268	.....
Lincoln.....	5,500	2,600	30,300	2,400	4,200	.....	1,650	.....
Mason.....	.....	.....	.....	.....	.....	.....	.....	8,000
Okanogan.....	5,398	91	4,791	.....	1,266	104	.....	.....
Pierce.....	23,630	13,804	.....	5,060	14,680	.....	65,885	.....
Skamania.....	1,830	.....	100	600	5,330	.....	1,000	.....
Snohomish.....	9,800	1,550	.....	1,200	1,900	.....	40,700	.....
Stevens.....	23,006	5,043	4,081	6,750	11,490	.....	3,978	.....
Thurston.....	.....	.....	.....	.....	.....	.....	.....	38,000
Walla Walla.....	.....	.....	.....	.....	.....	.....	.....	19,698
Whitman.....	610	5,267	26,633	3,020	12,980	10,550	650	.....
Yakima.....	427,089	38,682	319,066	42,500	18,390	5,500	22,000	.....

## HAY.

Alfalfa is the principal hay crop raised in the irrigated parts of Washington. Sagebrush land is generally short of humus, which alfalfa rapidly puts into the soil. It grows best on sandy loam, provided the subdrainage is good. This crop, later plowed under, enriches the soil and puts it in excellent condition to receive orchard trees or field crops. In many places where there are adjacent pasture lands the hay crop is sold in the stack to be fed on the ground. There is a growing demand for alfalfa hay, baled and on board the cars, for shipment to dairies.

## AMOUNT OF WATER USED IN CROP PRODUCTION AND PROFITS.

## ALFALFA.

In 1905 the writer made a careful study of the amount of water used in crop production. The following table is a summary of the results obtained from the study of alfalfa production for 1905:

## Alfalfa production, 1905.

Name.	Area.	Yield.	Cost of production.	Profit per acre.	Depth of water used per acre.	Depth used per ton produced.
	<i>Acres.</i>	<i>Tons.</i>			<i>Inches.</i>	<i>Inches.</i>
William McDonald.....	18	145.0	\$177.70	\$30.30	36.0	4.5
E. C. Speckker.....	17	112.0	206.25	20.75	22.5	3.4
G. E. Redman.....	11.5	81.7	115.55	22.00	39.0	5.5
A. F. Randolph.....	20	145.0	117.41	22.00	.....	.....
H. O. Barrick.....	105	815.0	948.00	.....	21.0	2.6
S. L. Burrill.....	38	329.0	439.60	26.60	44.7	5.1

The current price of hay in 1905 was \$5 per ton, and is higher at the present time. Alfalfa lands in crop are valued at \$150 to \$250 per acre.

## POTATOES.

In general, in most of the irrigated districts, where lands are not too expensive, a potato crop yields good profits. They require less water and less labor in handling than alfalfa. The following tabulation gives the results of investigations for 1905:

*Potato production, 1905.*

Name.	Area.	Yield.	Gross receipts.	Cost of production.	Profit per acre.
	<i>Acres.</i>	<i>Tons.</i>			
Harry W. Fisk.....	8	80.00	\$1,040.00	\$321.50	\$90.00
S. M. Campbell.....	4	32.13	450.00	127.00	80.40
Do.....	5	31.11	477.50	155.80	64.34
Do.....	10	81.50	914.76	444.50	47.00

The first three of the above were planted on alfalfa sod; the last was rowed between young trees. The 27 acres yielded 227.74 tons of marketable potatoes. The cost of production was \$1,410.50, or about \$6.20 per ton. To this must be added 75 cents per ton for loading on the cars, making the total cost f. o. b. \$6.95 per ton, and leaving a net profit of \$68 an acre. A mean depth of 17.6 inches of water was used, or 2 acre-inches per ton of potatoes produced.

## IRRIGATION IN THE COLUMBIA BASIN.

## CLIMATE OF THE COLUMBIA BASIN.

Generally speaking, the Columbia Basin and the valleys of its feeding streams are arid, covered with sagebrush, and having but scanty rainfall and long, dry summers. The rainfall is heaviest in the foothills and least at the river. Likewise the temperature is coldest in the foothills and mildest on the river. During July and August the temperature ranges high, but is less oppressive, owing to the clear, dry atmosphere. On account of the wide expanse of sagebrush plains, upon which there is very little to check air movements, this country is somewhat windy during the spring months. In general, however, no damage is done, except upon unseeded sandy land. Such lands may be cleared of sagebrush and seeded later in the summer with little or no trouble.

## THE OKANOGAN RIVER VALLEY.

The Okanogan River, heading in British Columbia, flows across Okanogan County, in the north-central part of the State, to its junction with the Columbia. This is a sluggish stream, and the lands

adjoining are generally in benches and so high that water can not be brought onto them from the Okanogan River.

Where Salmon River comes down out of the mountains and joins the Okanogan River, there is a series of flat, treeless benches that stretch up and down along both sides of the Salmon River for miles. These benches lie all the way from 100 to 400 feet above the river and, together with bottom lands along the Okanogan River, aggregate perhaps 25,000 acres of choice land. The largest of these extensive benches or flats, containing about 15,000 acres, lies immediately to the north of Salmon River and is called Pogues Flat. It is 10 miles long and 3 to 4 miles wide. The Federal Government, by putting in storage reservoirs and diverting the flow of Salmon River, is watering 10,000 acres on this flat.

South of the mouth of Salmon River is a bench prairie similar to the one above, known as Tarheel Flat, which contains about 4,000 acres of irrigable land. On the Colville Indian Reservation, across the river, are some fine low terraces that some time will likely be watered by pumping from the Okanogan River.

#### THE OKANOGAN PROJECT.

The lands located on the west bank of the Okanogan River that are being watered by the Government are 850 to 1,350 feet above sea level. They are composed of sand, light loam, and volcanic ash and gravel. Of the 10,000 acres to be served by the Government project, 1,425 acres are at present irrigated by private ditches. The lands under this project lie in three benches, are generally level, and are covered with bunch-grass and light sagebrush. About 3,000 acres are now watered and under cultivation; some seeded to alfalfa, and a considerable part planted to orchards. Orchards have been bearing for fifteen years, yet such fruits as peaches, pears, apples, cherries, and apricots have never failed to produce a crop. The winter temperature reaches zero and the summer from 75° to 100° F. The temperature for the year has a maximum of 105° and a minimum of -10°.

These lands are located pretty well up out of frost drainage, and are out of the reach of warm spring winds that sometimes start fruit buds prematurely.

Under the Okanogan project the farm unit is limited to 40 acres, and the water to 3 acre-feet per acre per season, or the equivalent of 36 inches of rainfall. The water for this project is taken from the Salmon River, the watershed of which covers an area of 140 square miles. The average rainfall on the drainage area is 17 inches and the average discharge is 30,000 acre-feet. The reservoir has a capacity of 15,000 acre-feet. The total length of the canal is 30 miles. Flood

waters have been furnished during the season of 1908. The storage works will likely be completed in 1909.

#### BREWSTER FLATS PROJECT.

This project extends from the junction of the Okanogan with the Columbia northward to Ophir. The irrigable lands directly under this project comprise 18,124 acres, being Brewster Flats and the lands lying immediately below the canal from the intake on the Methow River to Brewster Flats. In addition to the above acreage, there are several tracts of land lying adjacent to it that will be reclaimed by this canal, making in all approximately 30,000 acres. These lands lie in a series of benches between the elevations of 750 and 1,300 feet, sloping back from the Okanogan and Columbia rivers to the foothills. The lower benches are covered with a heavy growth of sagebrush. The upper benches, comprising about one-half of the land, grow a good quality of bunch grass. The soil is a deep, sandy loam, containing volcanic ash and a large percentage of potash and phosphates. All of the benches slope perfectly for irrigation and drainage and require practically no leveling.

The irrigation system for these lands will consist of a concrete weir, constructed in the Methow River 24 miles above its mouth, which will divert the water of said stream into the main canal, which follows along the east bank of the river to its mouth and from there up the north bank of the Columbia River to Brewster Flats, a distance of 44 miles. The concrete weir, canals, flumes, and other constructions necessary are all patterned after similar works of the U. S. Reclamation Service. Most of these lands have recently gone into the hands of private owners, who have organized a company to develop them. The water used on the low benches will be used to develop power for pumping and for lights.

Choice unimproved irrigable lands under the Brewster Flats project are now selling for \$250 per acre, including a paid-up water right.

The only means of transportation at this time is a daily steamboat service from Wenatche, where connections are made with the main line of the Great Northern Railroad. Fruit shipments from the Brewster Flats district to outside points take the same rate as Wenatche fruit.

In view of the fact that the Great Northern Company has secured its right of way across the greater portion of the Wenatche-Colville extension, which skirts Brewster Flats, it is reasonable to assume that before the Brewster Flats project is completed this line will be in full operation, affording transportation to eastern and coast markets, as well as supplying a direct route into the Canadian Northwest, a



vast territory rapidly settling up and unable to grow fruit by reason of the severe climate. The following table shows the amount of water available:

*Monthly discharge of the Methow River at Pateros, Wash., for 1905-6.*

[Taken from Reports of the U. S. Geological Survey.]

Month.	Maximum.	Minimum.	Mean.	Total.
	<i>Cubic feet per second.</i>	<i>Cubic feet per second.</i>	<i>Cubic feet per second.</i>	<i>Acre-feet.</i>
1905.				
January.....	528	400	480	29,510
February.....	552	400	506	28,100
March.....	1,988	486	1,291	79,380
April.....	5,860	1,372	2,517	149,800
May.....	7,296	3,050	4,110	252,700
June.....	10,960	5,164	7,749	461,100
July.....	5,066	1,602	2,839	174,600
August.....	1,428	603	899	55,280
September.....	630	528	553	32,910
October.....	1,072	630	792	48,700
November.....	791	528	678	40,340
December.....	576	450	517	31,170
For year.....	10,960	400	1,910	1,383,590
1906.				
January.....	600	420	478	29,400
February.....	468	400	430	23,900
March.....	690	420	455	28,000
April.....	3,920	723	1,970	117,000
May.....	11,200	3,220	5,040	310,000
June.....	9,000	3,130	4,770	284,000
July.....	3,920	826	1,990	122,000
August.....	791	507	613	37,700
September.....	507	450	564	33,600
October.....	756	435	492	30,300
November.....	1,370	603	749	44,600
December.....	603	450	549	33,800
For year.....	11,200	400	1,508	1,094,300

The minimum flow of the river, as shown above, will supply ample water to irrigate 50,000 to 60,000 acres of land, which is probably far more than can ever be reached by water from this stream. All water contracts on the Brewster Flats project call for 1 cubic foot of water per second for each 160 acres of land. Water will be delivered to the water users through suitable gates built in the main and lateral canals. These will be operated by and under the control of the company.

#### METHOW VALLEY.

The Methow Valley lies to the west of the Okanogan, over a range of low, rather flat-topped hills. The canyon is narrow, the hills generally coming close to the river. There are exceptions where small creeks discharge into the river in the lower part. There are many small, narrow farms and orchards along the Methow and its tributaries. From Libby Creek to the north the valley widens and at the discharge of Beaver Creek is about 2.5 miles wide. Again, farther up, at Winthrop there is quite an extended valley. About 1,600 acres are watered from Beaver and Frazer creeks, and there is a possibility of 300 acres more.

The fall on the Methow and its tributaries is very rapid, being about 25 feet per mile from the Twisp to the Columbia (the Twisp falls 52 feet per mile) and so only short, inexpensive ditches are required to bring the water out onto the land. This also furnishes some splendid opportunities to develop power. From the mouth of the Methow to Gold Creek about 400 acres are watered and 1,000 more can be irrigated by gravity. Gold and Libby creeks water nearly 1,000 acres. These lands are largely devoted to alfalfa with some domestic orchards and berry patches.

Up the river from Twisp private ditches and some small company ditches cover 9,000 acres. Of this, the Barkly Ditch now waters 500 acres and later will cover 500 acres more.

The Bush Irrigation Company covers 1,550 acres; one-third of this is now under cultivation. This is a new ditch and the balance will soon be planted to orchards or seeded to grass.

The Foghorn is a farmers' ditch covering 1,300 acres of ranch land, one-half of which is now under cultivation. This ditch heads in the Methow. The crops are alfalfa and some corn, with domestic orchards. Apples are said to be a fine crop. The alfalfa yield is placed at 6 tons per acre. In the winter of 1907-8 alfalfa sold for \$8 per ton. Lands sell at \$50 to \$75 per acre.

In the upper Methow Valley there is nearly 4,200 acres in single ranches watered by private ditches. It is estimated that 5,000 acres in the forest reserve, now covered with inferior timber, could be irrigated. There are also 2,500 acres of high bench land that could be watered. All of the above lands are less than 2,000 feet elevation.

Lands under private ditches and the older company ditches are improved, and only occasionally is a piece offered for sale.

The Methow Canal Company takes water from the Twisp River 4 miles above Twisp. The water is conveyed mostly by flumes to a point opposite Twisp and 100 feet above the town, where the flow is divided, a part being carried across the river and over to the east side through 3,000 feet of 20-inch wood-stave pipe. From here the water flows mostly in ditch for 12 miles down the east side of the Methow River. On the west side a ditch extends 10 miles beyond the point of division.

There are 4,500 acres under ditch, mostly at an elevation of over 1,400 feet. One cubic foot per second is allowed for each 160 acres. The amount of water claimed is 500 cubic feet per second. Under this canal there is yet a considerable body of land for sale. The company charges \$40 per acre for a water right and \$2 per year for maintenance, or they will give a water right for a deed to one-half of the land. The work on this project is nearly done and the company expects to supply water in 1909.

The Methow, being largely fed from snow fields on the east side of the Cascade Range, is in flood from April to August, when water is most in demand for irrigation. The U. S. Geological Survey reports for a series of years show plenty of water to irrigate all the land that can ever be put under ditch. The weather conditions are set forth in the following table:

*Weather conditions in the Methow Valley, Twisp Station.*

Month.	Maximum.	Minimum.	Rain.	Snow.	Date of frost.
1905.	°F.	°F.	Inches.	Inches.	
January .....	42	10	2.18	24.0	
February .....	50	18	.74	7.0	
March .....	61	25	1.38	.5	
April .....	81	26	1.17	.....	
May .....	88	30	.62	.....	May 2.
June .....	87	39	1.19	.....	
July .....	103	43	.77	.....	
August .....	102	37	.15	.....	
September .....	87	30	1.43	.....	September 29.
October .....	61	19	1.68	.....	October 2.
November .....	61	14	.79	7.0	
December .....	39	0	1.13	14.0	
For year .....	.....	.....	13.23	52.5	
1906.					
January .....	43	8	1.13	14.00	
February .....	49	4	1.26	8.00	
March .....	66	1	.49	.....	
April .....	86	25	.01	.....	April 26.
May .....	88	28	4.05	.....	May 5.
June .....	90	36	1.44	.....	
July .....	101	49	.24	.....	
August .....	99	42	.48	.....	
September .....	95	30	.09	.....	September 28.
October .....	85	19	.36	.....	October 3.
November .....	57	12	2.12	2.97	
December .....	45	9	3.56	44.00	
For year .....	.....	.....	15.23	68.97	
1907.					
January .....	38	18	.26	17.00	
February .....	51	5	.76	9.00	
March .....	53	8	.60	5.50	
April .....	79	22	.55	.....	
May .....	89	32	.94	.....	May 2.
June .....	99	36	1.13	.....	
July .....	101	39	.86	.....	
August .....	101	37	.08	.....	
September .....	89	33	1.34	.....	September 17.
October .....	83	29	.12	.....	October 3.
November .....	61	15	1.07	8.00	
December .....	41	9	2.94	40.00	
For year .....	.....	.....	11.65	79.50	

On account of the open range many cattle have been raised in this country, and consequently the chief crop has been hay. This has commanded a good price for winter feed, at which time the snow is deep and lasts for several months. Some corn is raised, and almost every farm has a small domestic orchard. Fruits, especially apples and berries, are said to produce good crops of fine quality. The summers are dry, hot, and full of sunshine. The soil in this valley is

somewhat heavier than in most of irrigated Washington, and ranges from clay to gravel.

The Methow Valley has not developed up to its best, and will not be until it has railroad transportation. It has been devoted largely to stock. At present considerable attention is being given to dairying, the butter being iced and hauled 28 miles from Twisp to Brewster, where it is picked up by a Columbia River boat and delivered to the Great Northern Railroad at Wenatchee. The development of the splendid water power at Chelan Falls by the Great Northern Company, which at present controls the power at that point, will likely lead to an electric line up the Methow Valley.

#### WENATCHEE RIVER LANDS.

The Wenatchee heads among the snow-capped summits of the Cascade Mountains near the southern boundary of the Washington National Forest. On its way to the Columbia it passes through Lake Wenatchee, some 6 miles long and situated in a beautiful basin, surrounded by towering peaks, upon which there is perpetual snow. Below the lake the valley grows narrower. The river gathers volume from its tributaries, and at last forces its way out from among the peaks through the famous Tumwater Canyon. It roars, leaps, and tumbles through this rugged, rocky, volcanic channel for 14 miles, until it finally emerges from the eastern portal. Here the scene abruptly changes. On either bank are fertile farms and beautiful orchards. The river no longer storms and roars, but runs smoothly and swiftly over a gravelly bottom. At various points part of its waters are diverted into irrigating ditches and canals. The towns of Leavenworth, Peshastin, Cashmere, and Wenatchee are located along its banks, each in the center of a thriving farming community. This farming country is about 30 miles long and varies from 1 to 5 miles in width. In the Tumwater Canyon, above Leavenworth, is the power development of the Great Northern Railroad, mentioned in another part of this bulletin. The drainage area of this river system, which covers 1,190 square miles, is mountainous and generally well timbered.

The following table gives the discharge of the Wenatchee River, as determined by the United States Geological Survey rating station at Cashmere.



*Estimated monthly discharge of the Wenatchee River at Cashmere for 1904,  
1905, and 1906.*

Month.	Maximum.	Minimum.	Mean.	Total.
<b>1904.</b>	<i>Cubic feet per second.</i>	<i>Cubic feet per second.</i>	<i>Cubic feet per second.</i>	<i>Acre-feet.</i>
July 27-31 .....	3,660	2,970	3,354	33,260
August .....	2,970	1,360	2,078	127,800
September .....	1,560	830	1,122	66,760
October .....	1,360	685	851	52,330
November .....	1,985	615	1,120	66,640
December .....	1,665	1,075	1,331	81,840
Total .....				428,630
<b>1905.</b>				
January .....	1,165	685	915	56,260
February .....	1,770	550	1,001	55,590
March .....	4,700	1,875	3,702	227,600
April .....	7,325	2,210	3,794	225,800
May .....	7,410	3,950	4,940	303,800
June .....	8,780	5,150	6,872	408,900
July .....	5,300	2,450	3,727	229,200
August .....	2,330	1,075	1,610	99,000
September .....	1,875	910	1,133	67,420
October .....	6,100	1,260	2,660	163,600
November .....	1,985	1,260	1,476	87,830
December .....	1,360	755	993	61,060
Total .....	8,780			1,986,060
<b>1906.</b>				
January .....	1,770	755	1,060	65,200
February .....	1,980	1,260	1,910	106,000
March .....	2,970	1,260	1,520	93,500
April .....	6,660	2,840	4,540	270,000
May .....	7,410	3,950	5,600	344,000
June .....	6,100	3,380	4,310	256,000
July .....	4,850	1,660	2,920	180,000
August .....	1,560	910	1,220	75,000
September .....	1,770	830	1,030	61,300
October .....	7,750	830	2,060	127,000
November 1-14 .....	10,500	1,980	3,210	89,100
December 27-31 .....	1,560	1,460	1,500	14,900
Total .....	10,500			1,692,000

At present there is about 20,000 acres under ditch from the Wenatchee and its tributaries, the Icicle, Peshatin, Mission, and Squillechuck creeks. A 75-foot lift, with abundance of power easily developed from the Wenatchee River, will put water onto 4,000 or 5,000 acres more of fine bench land. All of this would make a grand total of about 25,000 acres of irrigated lands in the valley of the Wenatchee River. Such an acreage would not require more than one-fourth of the minimum flow of the stream during the irrigation season.

#### MILLER DITCH.

The first little stream of water used in the valley was taken from Squillechuck Creek in 1870. It was used to irrigate about 1 acre of garden. This was enlarged and extended later into the Miller Ditch, which now covers a large acreage. Some raw lands under this ditch were sold in 1908 for \$700 per acre; 3-year-old orchard sold for \$1,200.

#### WENATCHEE WATER POWER COMPANY.

The Wenatchee Water Power Company has an appropriation of 150 cubic feet per second from the Wenatchee River. This is con-

ducted through 6 miles of main ditch and 12 miles of laterals. The company waters 1,500 acres of land. It supplies 2.5 acre-feet of water per acre and measures the water to the user over a weir. At present the canal is operated by the company, but steps are being taken to turn the system over to the settlers under the ditch. Water rights originally cost \$30 per acre; now they cost \$100 per acre. Maintenance charges are \$1.25 to \$1.50 per acre.

#### WENATCHEE CANAL COMPANY.

The High Line Canal was constructed in 1902 and 1903. It originally covered 6,000 acres. The recent extension across the Columbia River covers 5,000 more. The Wenatchee Canal Company provides 1 cubic foot per second to each 100 acres and charges a maintenance fee of \$1.50 per acre. Sixteen miles of ditch has already been constructed on the east side of the Columbia River. The water for east-side land is carried over the river on a steel cantilever bridge costing \$175,000. A 42-inch banded wooden stave pipe carries the water to the bridge, where it divides and crosses the bridge in two 36-inch wood stave pipes under a pressure of 235 feet. On the east side of the river it is again carried by one pipe up to the ditch, which distributes it both up and down the river. The ditches, flumes, pipe lines, and bridge are substantially constructed. The lands watered by this company are high, well drained, and generally covered with thrifty young orchards.

#### CLIMATE.

The fact that this valley is one of the chief fruit centers of the State, and that the fruit covers varieties ranging from apples to apricots, is sufficient guaranty that the winter weather is not severe and that the country is not seriously damaged by late spring and early fall frosts. In summer the midday heat sometimes reaches 100° to 110° F. The proximity of the valley to high mountains on the west usually materially reduces the temperature at night. This is a land of sunshine; the days are mostly cloudless. The 6 to 8 inches of precipitation comes late in the fall, winter, and early spring.

#### YAKIMA RIVER LANDS.

The Yakima River and its tributaries head in the Cascade Mountains and drain an area of about 5,300 square miles. It flows generally in a southeasterly direction, and on its way to the Columbia passes through five distinct drainage basins or valleys separated from each other by basaltic ridges formed by the tilting of the underlying lava. In wearing a way through these ridges the river has cut deep canyons. The sedimentary floors of the basins gently slope toward and with the river. The lower lands, next to the river, have gravelly

subsoil covered by only a few inches to a few feet of sandy soil. Upon the benches, which are characteristic of these basins, the soil is usually deep and requires less water for crop production.

The total irrigable area of the Yakima basins approximates 600,000 acres, of which about 10,000 is in the Clealum district, 75,000 in the Kittitas Valley, 100,000 in Selah and Moxee valleys or north of the Yakima district, 185,000 in the Yakima Indian Reservation and the Sunnyside district, and 230,000 in Benton County, bordering the Columbia River south of Priest Rapids. Of this area, about 145,000 acres is now under cultivation and is receiving water from the natural discharge of the Yakima River. This irrigated area is distributed approximately as follows: Clealum district, 3,000 acres; Kittitas Valley, 25,000 acres; about North Yakima, 54,000 acres; Reservation and Sunnyside districts, 54,000 acres; Columbia River district, 9,000 acres.

#### DISTRIBUTION AND REGULATION OF THE WATER SUPPLY.

The low-water flow of the river has all been in use for several years and any future developments must be irrigated with stored water. Prior to July, 1906, a large percentage of the water users, represented largely by companies, signed an agreement with the Federal authorities limiting their respective diversions to the average diversions during August, 1905. This was preliminary to the purchase of the Sunnyside interests, the development of the Tieton project, the construction of storage reservoirs at the lakes, and the development of any other projects contemplated in the Yakima Valley. There is a wide difference among those signing as to the amounts of water needed for the respective lands. This may become a question of fact to be determined by a jury at some time. The agreement left practically all the legal questions to be disposed of in the future, its only purpose being to so distribute the natural flow of the stream that any waters stored could be available for new developments. It also forever estops the contracting parties from claiming more water than that stipulated in the joint agreement and gives them no rights which they did not have previously, nor is the agreement broad enough to settle prior rights to the use of water. No doubt many of the quantities stipulated in the contract are much in excess of the needs of the land, and possibly in some instances the lands have no just claims to any water at all, or at least not during extreme low stages of the river.

The following table shows the parties to this agreement, together with those who had not entered into the agreement prior to July, 1906, for whom no figures are given in the last column. It also shows the average diversion by all parties and the amounts to which the subscribers limited themselves.

*Average diversions and amounts of apportionments under the agreement made  
prior to July, 1906.*

Name of district and ditch.	Diversions.	
	Average.	Agreed.
	<i>Cubic feet per second.</i>	<i>Cubic feet per second.</i>
Kittitas Valley:		
Ellensburg Water Company.....	125	124
The West Side Irrigation Company.....	66	62
Olson et al.....	20	23
Fogarty.....	7	.....
Bull Canal Company.....	23	.....
Total.....	241	209
Yakima Valley:		
Selah-Moxee Company.....	78	78
Taylor Ditch Company.....	17	23
The Moxee Company.....	32	38
The Fowler Ditch Company.....	23	23
William Granger.....	3	2
Total.....	153	164
Naches Valley:		
John Schuller (included in No. 26).....	1	.....
Selah Development Company.....	66	105
Clark et al.....	19	.....
Sinclair & Cobb.....	6	2
Addison Cobb.....	1	.3
Wapatox Ditch Company.....	45	50
Foster, Naches Canal Company.....	1	.....
Shafer et al. (Lowery).....	17	.....
Allen et al. (Kelly).....	2	.....
Upper Scott (Lee et al.).....	6	.....
La Fortune Ditch Company.....	7	.....
Lower Scott (John Cox et al.).....	5	.....
Basket Fort or Lasswell.....	4	.....
Naches Canal Company (Gleed).....	75	67.25
John Marissy et al.....	4	3.50
Yakima Valley Canal Company.....	61	62.50
Schuller and Rodenbach.....	4	4
Leach and White.....	8	6
McCormack and Long.....	8	5
Chapman et al.....	6	5
Nelson et al.....	7	4.5
Naches and Cowiche Ditch Company.....	43	40
Broadgauge Ditch Company.....	10	9.12
Northwest Light and Water Company (Incorporated).....	6	.....
The New Shanno Irrigation Company.....	30	15
Fruitvale.....	10	10
R. S. and C. Irrigation Company.....	9	12
Old Union Ditch Company.....	65	65
City of North Yakima.....	18	2
Rodenbach.....	0	1.5
Total.....	544	469.67
Between Union Gap and Kiona:		
Indian Reservation canals.....	269	.....
Sunnyside Canal.....	626	.....
Prosser Falls Light and Power Company.....	8	30
Northern Pacific Irrigation Company.....	32	23
Total.....	935	53
Northern Pacific Irrigation Company.....	111	175
Grosscup (The Yakima Company).....	7	.....
Amon (Benton Water Company).....	4	.....
Total.....	122	175
Waste into the Columbia River.....	100	.....
Grand total.....	2,095	1,070.67
Partially defined claims, estimating defined portion.....		15.43
Partially defined claims, estimating undefined portion.....		15.44
Total defined claims.....		1,833.10
Total undefined claims.....		110.44
Grand total.....		1,993.54
Margin to meet possible future claims.....		101.46
Grand total of diversions plus all claims and margins.....		2,095.00



Besides the flow of the Yakima River, there are several small tributaries from which the early settlers took water to irrigate riparian and closely adjoining lands. The acreage was usually large and the water supply small, consequently disputes arose and were carried to the courts, which in time handed down decrees settling priorities, quantities needed, and distributing the water among the appropriators. There is approximately 41,000 acres irrigated from creeks and artesian wells, where the supply is definite and the use in most instances resting on a court decree.

## CLIMATE.

The weather conditions of the lower Columbia Basin south and west from Priest Rapids, as far as irrigation is practiced, are not far different from those at Kennewick, as hereafter tabulated. The temperature is generally mild, the rainfall scanty, the summer sky clear, and there is more or less wind during the spring months.

The following table, compiled from the Weather Bureau reports, will show comparative weather conditions along the Yakima River:

*Climatic data on the Yakima Valley.*

Month.	Ellensburg. <sup>a</sup>		North Yakima. <sup>b</sup>		Sunnyside. <sup>c</sup>		Kennewick. <sup>d</sup>	
1905.	<i>Inches.</i>	<i>° F.</i>	<i>Inches.</i>	<i>° F.</i>	<i>Inches.</i>	<i>° F.</i>	<i>Inches.</i>	<i>° F.</i>
January.....	1.81	27.6	1.19	32.0	0.87	31.8	.....	.....
February.....	.36	29.3	.28	31.0	.30	33.4	0.11	35.2
March.....	.41	44.7	.48	47.0	.48	47.8	.45	50.0
April.....	.16	49.2	.16	51.2	.00	51.8	.04	55.4
May.....	.54	54.0	.71	56.4	.75	57.8	.88	59.8
June.....	4.54	61.3	3.65	63.2	1.12	64.3	.....	.....
July.....	.15	67.3	Trace.	71.8	Trace.	72.5	.....	78.2
August.....	.34	66.2	.07	68.2	.13	68.0	Trace.	74.2
September.....	.38	58.4	.40	60.8	.52	62.2	.16	66.6
October.....	1.42	40.0	1.32	45.2	1.72	44.8	.78	48.0
November.....	.47	36.0	.25	36.9	.22	.....	.46	39.0
December.....	.77	28.5	.55	31.4	.37	.....	.....	33.3
Annual.....	11.35	46.9	9.06	49.6	6.48	.....	2.88	.....
1906.	<i>Inches.</i>	<i>° F.</i>	<i>Inches.</i>	<i>° F.</i>	<i>Inches.</i>	<i>° F.</i>	<i>Inches.</i>	<i>° F.</i>
January.....	1.08	29.2	1.16	30.5	.46	.....	.23	36.0
February.....	1.20	35.2	.90	37.7	.99	38.2	1.00	39.9
March.....	1.02	37.6	1.23	39.8	.86	40.6	.87	43.2
April.....	.00	51.5	.00	53.7	.11	54.6	Trace.	57.8
May.....	1.23	55.7	1.11	58.2	.98	58.4	.93	62.2
June.....	.87	57.1	.69	60.8	.46	61.3	.02	66.3
July.....	.09	75.2	.08	78.9	Trace.	77.0	Trace.	86.4
August.....	.33	67.4	Trace.	69.9	Trace.	69.8	Trace.	76.0
September.....	.27	59.0	.24	62.4	.27	60.8	.03	64.6
October.....	.20	48.5	.12	52.4	.07	53.0	.51	55.4

<sup>a</sup> Approximate altitude 1,577 feet.

<sup>b</sup> Approximate altitude 1,078 feet.

<sup>c</sup> Approximate altitude 764 feet.

<sup>d</sup> Approximate altitude 363 feet.

From 1898 to 1905, inclusive, the mean annual precipitation was 9.47 inches at Ellensburg, 9 inches at North Yakima, and 6.28 inches at Sunnyside. Kennewick records covering this period are not complete, but the mean would be less than at Sunnyside. The mean annual temperatures from 1898 to 1905, inclusive, were: At Ellensburg, 46.7° F.; North Yakima, 49.5°; Sunnyside, 50.8° (excluding

1905). At Kennewick for 1898-99 the mean was 54.3°. Subsequent records are incomplete. In 1905 every 3.5 acres of irrigated land in the Yakima Valley supported one person, and the average assessed valuation per acre for the entire river system was \$61 per acre. In this estimate was included a large body of grass lands. In the fruit and truck regions the acreage per individual is less and the assessed value considerably higher.

#### CLEALUM BASIN.

The Clealum Basin generally lies below 2,000 feet and extends in rather a narrow strip for 10 miles along the Yakima River and in a much narrower strip along the Teanaway River. North, south, and west there are high, timbered hills. A short distance up the river are the lakes which are to be converted into great storage reservoirs. The soil in this valley, except for being a little heavier, is very similar to that in the Kittitas. The crops raised are the grasses and cereals.

#### KITTITAS BASIN.

The Kittitas Valley is approximately 25 miles long from north to south and 10 miles wide, having an area of about 150 square miles. The Yakima River flows through it from north to south and receives the drainage of several small streams which rise in its mountainous borders. Its rim is composed of Columbia lava and on the north and west is between 5,000 and 6,000 feet elevation. The general level of the bottom is between 1,500 and 1,600 feet. The streams draining the elevated rim have cut canyons many hundred feet deep through the solid basalt, but the same streams, on emerging into the valley, flow over the surface of the alluvial bed without forming channels. Instead of cutting, they are depositing the materials derived from the hard rocks on their upper courses. This is due to the gentle slopes of the floor of the valley. Fortunately, the Kittitas Valley is so situated with reference to the Yakima River and the creeks draining its high borders that nearly all its agricultural lands can be irrigated. This valley is without trees, except a few cottonwoods and brush along the streams, but it supports a rank growth of sagebrush. The hills to the west and north are covered with scattering pines, hemlock, and spruce. The soil is rich, being exceptionally so on the uplands, where the disintegration and weathering of basaltic rocks have produced a fine, dark-colored soil.

The agricultural lands in the Ellensburg basin are almost exclusively confined to the areas of alluvium. They include the terraces and bottoms and generally a narrow strip of land along the streams, composed mostly of washed gravel and boulders, with very little or no soil covering. The alluvium is very rich in lime, the abundance of which, together with the very fine texture of the soil, renders

soluble and available a large percentage of its mineral constituents. Owing to the excessive use of water for irrigation in some parts of the valley, quite extensive areas have been materially damaged by bringing the alkali to the surface. Some of the progressive thoughtful farmers have reclaimed some of both the alkali and swamp lands by systematically laid underdrains. The principal crop is timothy hay.

#### CASCADE CANAL.

The Cascade Canal was the first of any importance to take water from near the headwaters of the Yakima River. This water right was filed after many other large appropriations had been made farther down. To protect their interests during low water the company in 1903 appropriated 1,000 cubic feet per second from Lake Kachess, and in February of the same year they filed on 500 cubic feet per second from the Yakima River. The original intention was to build a low rock-fill dam at the outlet of the lake for the purpose of storing water, but more satisfactory arrangements have since been made with the Federal authorities. In developing the Yakima Valley this lake will be used to provide a large amount of storage. The canal was built and is owned by a cooperative company of the farmers who own the lands and who are the only ones who can use the water from the ditch. The canal is 43 miles long, lying above the line of the Town Ditch, and covers 15,000 acres, about 9,000 of which is now under cultivation. These lands are devoted chiefly to hay and are valued at \$80 per acre, while those older and better improved which adjoin are selling for \$100 to \$250 per acre, depending upon the location and improvements. The maintenance charges are expected to be about 80 cents per acre.

#### WEST KITTITAS CANAL.

The West Side Irrigation Company, a cooperative association, owns the West Kittitas Canal, which heads in the Yakima River about 3 miles above Thorp. This canal covers 5,000 to 6,000 acres. The company was incorporated for 600 shares. The cost of maintenance is \$3 per share per annum, or about 35 cents an acre.

#### OTHER DITCHES.

*Olson Ditch.*—This ditch is owned and operated by a few farmers. It was originally built for sawmill purposes, but later was extended and used to irrigate some 1,200 acres. It heads in a slough near the intake of the Town Canal.

*Town Canal.*—The Ellensburg Water Company, a cooperative association with a capital stock of \$50,000, divided into 10,000 shares of

\$5 each, owns the Town Canal. It takes water from the Yakima River 9 miles above Ellensburg, and waters approximately 10,000 acres.

*Bull Ditch.*—This ditch heads in the tailrace of the Ellensburg flour mill, and in addition to the tail water picks up any waste that comes from Wilson Creek. This ditch covers 2,200 acres of land.

*Taneum Ditch.*—This ditch takes water from Taneum Creek, and by decree is to have two-thirds of the water of the creek. The ditch waters 4,000 acres for one hay crop. It is generally in bad order, having been built on improper grades.

*Monastash and Wilson creeks.*—Along these creeks there are several private and cooperative ditches, the water supply for which is covered by court decree.

### NORTH YAKIMA DISTRICT.

#### THE MOXEE AND ATANUM VALLEYS.

Some parts of Atanum Valley and of the region around Yakima were settled as early as 1860. About 8 miles west of Yakima the long, narrow valley of the Atanum widens and joins that of the Wide Hollow Slough. About 1 mile west of Yakima there is a sudden rise of 10 to 60 feet in the floor of the valley, forming a nearly level plateau. The Moxee Valley gently slopes from its relatively high eastern end toward the west to the Yakima River. Some parts of the eastern end of this valley are watered from artesian wells. In both of these valleys there are some alkali deposits due to excessive seepage from an over use of water on higher lands and to a lack of drainage. The elevation of this valley is about 1,000 feet.

During some parts of the summer the temperature is pretty high, but the humidity is low; consequently high temperatures are not oppressive. In general, the winters are mild, although the mercury may record zero occasionally. The snowfall is light in the valleys and soon disappears. The following table, compiled from the Federal weather reports, gives the dates of the last killing frost in spring and the first in the fall. The frost on June 28, 1898, touched most of eastern Washington.

*Dates of killing frosts.*

Year.	Last in spring.		First in fall.	
	Moxee.	Sunnyside.	Moxee.	Sunnyside.
1898 .....	April 2-4 .....	April 2-4 .....	.....	.....
1899 .....	June 28 .....	June 28 .....	.....	.....
1900 .....	May 13 .....	May 12 .....	October 1 .....	October 10 .....
1901 .....	April 27 .....	April 9 .....	September 26 .....	October 1 .....
.....	June 7 .....	April 24 .....	November 1 .....	November 1 .....



*Tieton project.*—This project, now in process of construction, covers approximately 24,000 acres lying west and north of North Yakima. This may be divided into three parts: (1) The Wide Hollow tract, lying just west and above the famous Knob Hill country at an elevation of 1,250 to 1,750 feet; (2) the Cowiche Basin, a very fertile basin lying between the two branches of the Cowiche Creek at an elevation of 1,570 to 2,140 feet, some parts of this valley being watered already from Cowiche Creek; and (3) the Naches Ridge, a flat ridge lying between the Cowiche Creek and the Naches River at an elevation of 1,500 to 2,100 feet. Water will be supplied from the Tieton River until such time as that may be needed to supply prior rights. Then stored water from the McAllister Meadows reservoir, which has a storage capacity of 35,000 acre-feet, will be used.

The soil is a volcanic ash and is further described under the Yakima Basin. The construction work under this project will be completed probably during 1909–10. Raw lands without water right, but under the Tieton Canal, are being offered for sale at \$60 to \$110 per acre. The cost of the water right can not be determined until the construction is completed. When the work is completed, and the cost per acre assessed, water rights can be secured. The estimated cost at the time of approving the project was \$60 per acre.

*Taylor Ditch.*—This ditch heads on the west bank of the river, nearly opposite the Selah-Moxee. It covers 1,500 acres and actually waters 1,000 acres of a very productive and beautiful valley.

*Selah-Moxee Canal.*—This canal heads well up in the Selah Valley from the east bank of the Yakima River, and after supplying water to several hundred acres of Selah Valley it passes the canyon of the Selah ridge, a distance of 5 miles, in a flume, and enters the Moxee Valley, where it waters about 4,000 acres. The development cost from \$75,000 to \$80,000. It is owned and operated by a stock company. The stock was divided into 6,000 shares, the intention being that each acre of land should be represented by one share of stock. These shares originally cost \$25 each. Later, the price was raised to \$35. The maintenance fee was formerly \$1.50 per acre, but was later raised to \$2. At present the stock is nearly all owned by farmers owning land under the ditch.

*Hubbard and Moxee ditches.*—These ditches take water from the Yakima River to irrigate 7,000 acres belonging to the Moxee Company and lying in the Moxee Valley. Water-right owners under the Moxee Ditch get 1 cubic foot per second for 160 acres, while those under the Hubbard Ditch get the same amount for each 100 acres. The maintenance charge in both instances is \$1 per annum.

*Fowler Ditch.*—The old Fowler Ditch, diverting water from the Yakima River, near the headings of the Moxee and the Hubbard ditches, and watering a small tract in the Moxee Valley, has recently



been extended around through Union Gap to cover about 2,800 acres along and immediately above the Sunnyside Canal. This tract lies immediately above the very excellent hay, hop, and fruit lands of Parker Bottom. The water supplied is 1 cubic foot per second to each 100 acres and the maintenance charge is \$1.50 per acre per annum. About 700 acres is offered for sale at \$200 to \$250 per acre.

#### NACHES VALLEY.

The part of this valley relying on irrigation to produce crops is about 10 miles long and from 1 to 2 miles wide. The Naches River is a very swift stream.

*Soil.*—The soil is composed largely of Lake John Day deposits and consists of alternate layers of fine volcanic dust, gravel, sand, and finer soils, and is similar to the Atanum and Moxee valley soils. The surface of this basin is covered with a few feet to 60 feet of soil, underneath which is a thick layer of waterworn gravel and cobblestone varying from 2 to 6 inches in diameter. Russell expresses the opinion that the Lake John Day deposits are one-half volcanic dust. The Bureau of Soils classes them as Yakima sandy loam. This soil is light, friable, and easily cultivated, and is generally of great depth and very fertile, and, therefore, when properly irrigated, adapted to the growing of any crop suited to the climate. The region consists of bottom lands and terraces. The bottom land generally has a gravelly soil, with a well-washed gravel subsoil. The bench soils are composed of fine silt and sand. This is one of the most beautiful and productive valleys in the State. Its elevation varies from 1,150 to 1,550 feet. The climate is somewhat milder in summer and more rigorous in winter than farther down at Yakima.

The crops most generally grown are hops, alfalfa, clover, timothy, fruits, melons, and vegetables. The fruits are apples, pears, peaches, and prunes.

Space will not permit a description of the very many small canals heading in the Naches River and watering in the aggregate a considerable acreage. Of the larger ones a few of the more important may be mentioned. Some of these water lands in the Naches Valley and some extend farther down and serve lands in the North Yakima district.

*Selah Valley Canal.*—This canal heads about a mile above the mouth of the Tieton River. It takes water from the left bank of the Naches, originally for 6,000 acres, but has been extended recently into the Selah Valley, where it covers 5,000 acres more. The company's contract makes the water appurtenant to the land, specifies a duty of 1 cubic foot per second for each 160 acres, and provides a maintenance charge of \$1 per acre per annum.

*Wapatox Canal.*—This is an irrigation and power canal. It irrigates about 180 acres of land in the Naches Valley, with a possibility of 700 to 800 acres more.

*Gleed Canal.*—This canal is owned by an incorporated company consisting of farmers. It diverts water from the Naches River for 1,800 acres of Naches Valley lands.

*Congdon Canal.*—The Congdon Canal, owned by the Yakima Valley Canal Company, diverts water from the Naches and carries it around into the Wide Hollow country immediately west of North Yakima and irrigates the famous Knob Hill orchards. The canal is owned by a cooperative company with 4,200 shares, or one share for each acre of land under the ditch. The maintenance charges are \$2 per acre per annum.

*Naches-Cowiche Canal.*—In 1881 a group of farmers appropriated water from the Naches River and constructed a canal to water lands west of North Yakima. This canal is operated by a stock company, there being 240 shares of stock. Each share is intended to supply water to 10 acres. Water rights in this company are personal property and are not appurtenant to the lands. Maintenance charges are very light.

*Shanno and Broadgage Canal.*—This canal takes water largely from the tailrace of the power canal to water about 1,600 acres near North Yakima.

*Union Canal.*—This canal takes water from the Naches River and from the tailrace of the power canal for about 2,300 acres of bottom lands lying in and around North Yakima. A considerable part of this land is river bar, presumably formed by the Naches River. The stock of this company is divided into 69 shares, or about one share for each 40 acres under the ditch.

*Town Canal.*—This canal is owned by the city of North Yakima and is used to water shade trees in the city.

#### RESERVATION AND SUNNYSIDE BASIN.

South of Union Gap and extending along the Yakima River for nearly 60 miles is a fine body of low-lying land. South and west of the river is the Yakima Indian Reservation. These lands slope gently toward the river and to the east. To the north and east are the Sunnyside lands, lying mostly on a bench up from the river and having generally very deep, rich soil composed principally of Yakima sandy loam, some parts of which, south and east of Sunnyside, are classed as Sunnyside sand, generally known as "volcanic ash." The soil covering the reservation lands varies from 1 to 6 feet deep and is composed of volcanic ash superimposed upon porous gravel and some river wash. The rainfall in this basin is from 6 to 8 inches

annually. Potatoes, melons, grains, and hay are the principal crops on the reservation.

Under the Sunnyside Canal, on the Yakima sandy loam, will be found some of the finest orchards in the State. Much of the Sunnyside sand produces 8 tons of alfalfa per acre and supplies pasture and winter feed for many thousands of sheep and cattle. This whole valley produces abundantly everything adapted to a Yakima climate, such as apples, pears, peaches, nectarines, apricots, prunes, plums, grapes, cherries, small fruits, hops, alfalfa, timothy, clover, potatoes, corn, and vegetables.

#### CANALS SUPPLYING WATER TO THE YAKIMA INDIAN RESERVATION.

*New Reservation Canal No. 2.*—This canal, partially built in 1903 and later extended, now covers 34,000 acres, the major part of which is yet in sagebrush. It diverts water from the Yakima River just below Union Gap, and such part as is completed was designed to carry 1,000 cubic feet per second.

*Reservation Canal No. 1.*—The old reservation canal heads lower down, and carries water for 18,000 acres. This canal was built to carry 235 cubic feet per second.

*Gilbert Ditch.*—This ditch heads in a slough and diverts water for 3,000 to 4,000 acres of leased Indian lands. With the expiration of the leases the land and ditches revert to the Indian owners.

*Other ditches.*—The old reservation ditch No. 3 diverts a small amount of water from the Atanum. Other small ditches water about 3,000 acres. The Hatch Ditch is a private enterprise, watering about 600 acres of leased Indian lands.

#### SUNNYSIDE CANAL.

This canal heads in the Yakima River below Union Gap, and claims 1,000 cubic feet per second. The canal is about 57 miles long and is designed to water 68,000 acres. Of this area about 43,000 acres are now under cultivation. The crops are fruits of all kinds, potatoes, melons, hops, and hay, principally alfalfa. The company owned originally every alternate section and sold a perpetual water right with all lands. The prevailing price for lands with a perpetual water right is from \$75 to \$250 per acre. Lands holding no water right could secure the same for \$30 per acre, or rent water for \$2.50 per year. The maintenance charge for all lands with a water right is \$1 per acre per year.

In 1906 the Washington Irrigation Company sold this canal to the Federal Government, under the plans of which, as reported in the Fourth Annual Report of the Reclamation Service, it will be extended to cover 84,000 acres. The contracts provide for delivering

3 acre-feet of water per acre annually. The company has for sale about 2,700 acres of land at prices as stated above.

The soil conditions for this and the reservation lands across the river have been discussed in another part of this bulletin (p. 16).

The rainfall is 8 inches per annum and comes mostly in winter. The average temperature is 55°. Late spring frosts sometimes damage some varieties of fruit, but never destroy a crop entirely. The last serious frost may be expected about April 15.

The following table on yields under the Sunnyside Canal is compiled from data supplied by Walter N. Granger, manager of the Sunnyside project, and may be considered conservative.

*Yield, prices, and net profits of crops under Sunnyside Canal.*

Crop.	Yield.	Price in 1908.	Average profit per acre.
Apples (8-year trees) .....	20 boxes per tree .....	\$1.25 per box .....	\$300
Pears (8-year trees) .....	12 boxes per tree .....	\$1 per box .....	
Peaches (6-year trees) .....	20 boxes per tree .....	\$0.50 per box .....	
Alfalfa .....	8 tons per acre .....	\$5 per ton .....	30
Timothy and clover .....	5 tons per acre .....	\$8 per ton .....	
Potatoes .....	8 tons per acre .....	\$15 per ton .....	
Corn .....	60 bushels per acre .....	.....	100
Hops .....	1 ton per acre .....	.....	

#### PROSSER FALLS.

The Prosser Falls Land, Irrigation, and Power Company irrigates about 1,600 acres on the south side of the river opposite the Sunnyside project. The water for this land is lifted 100 feet by pumps, being forced through 1,800 feet of 28-inch steel pipe to a penstock from which the canal heads. The turbines driving the pumps operate under a head of 17 feet. The early contracts provided 1 cubic foot per second for 120 acres; the later ones agree to give only 1 cubic foot per second for each 160 acres. Water rights cost \$75 per acre; maintenance charges are \$1.50 per acre.

The soil and climatic conditions generally are quite similar to those under the Sunnyside Canal.

#### IRRIGATION IN REGIONS HAVING NO OUTLET.

The eastern half of Douglas County, in the very center of the Columbia Basin, has many small lakes and creeks, but no outlet. Regardless of the fact that the soil is naturally alkaline, three irrigation projects have been developed in this region.

#### MOSES LAKE DEVELOPMENT COMPANY.

The Moses Lake Development Company is lifting water 50 feet with a 40-horsepower gas engine to irrigate 325 acres, 35 acres of



which is now in young orchard. This land is to be sold in 5 and 10 acre tracts. Maintenance charges are \$2.50 per acre per year. Near Moses Lake is a 20-horsepower gas outfit lifting water from a well dug 29 feet into gravel. Lands in the vicinity are excellent.

#### IRRIGATION IN THE GRAND COULÉE.

Near Coulée City, in the bottom of the Grand Coulée, walled in on all sides by 300 feet of perpendicular basalt cliffs, is a 1,200-acre farm, some of which is watered by gravity, but most of which could be profitably watered by pumping. There is 30 acres now in grains and orchard, yielding good profits.

#### ADRIAN IRRIGATION COMPANY.

Near Adrian, on the Great Northern Railroad, the Adrian Irrigation Company is installing a pumping plant at Brook Lake, and is preparing to water about 2,000 acres from the natural flow of Crab Creek, to be supplemented by the storage from the lake. This project is to be operated as a socialistic colony, and will be conducted by a manager and a board of directors. It is intended to be an investment and a revenue producer to artisans who are employed elsewhere.

#### COLVILLE RIVER VALLEY.

##### FRUITLAND IRRIGATION COMPANY.

The Fruitland Irrigation Company has the work nearly done to put water onto about 6,000 acres on the east bank of the Columbia River in Stevens County. The tract extends from Kettle Falls south about 24 miles. The strip is narrow, slightly timbered, and may be classed as bottom land. It is generally sandy, mixed in places with fine gravel and underlaid with coarse river gravel. Water is taken from the Colville River below Meyers Falls. These lands are closely backed up on the east by a range of timbered hills beyond which the Colville River flows north to its junction with the Columbia. On the west of the Columbia is another line of timbered hills.

The Colville Valley is noted for its good farms and its fine apples. The rainfall at Kettle Falls is considerably more than in some other irrigated districts of the State, but yet not enough to produce maximum crops without irrigation during the drier part of the season. The lands are owned generally by farmers. Some settlers have been dry farming a good many years. Some places, watered by springs and creeks, have shown the fitness of the country for fruit, melons, and similar crops. Being surrounded by timbered hills, this valley is protected from high winds. The climate is exceptionally good.



At present the transportation facilities are not good. All produce must be hauled up the valley to Meyers Falls or over the hills to stations along the Great Northern in the Colville Valley. An electric line will soon traverse the Fruitland irrigation tract from the south, giving an outlet to Spokane and the transcontinental lines.

#### PLANTATIONS COMPANY.

The irrigated lands of the Plantations Company are located between Meyers Falls on the Spokane Falls and Northern Railroad and Kettle Falls on the Columbia River. They have an elevation of 1,600 feet. This is high bench land and adjoins the Fruitland irrigation properties on the north. Water is to be lifted 105 feet by water power into a 100,000-gallon reservoir, from which it is to be carried in a 20-inch wood stave pipe under pressure and delivered to each 10-acre lot from a hydrant. Contracts call for 1 acre-foot of water per acre to be delivered between May 1 and September 15. Twelve hundred acres is to be supplied with water May 1, 1909. The lands have been put on the market at \$250 per acre.

#### SPOKANE VALLEY.

The Spokane Valley comprises a comparatively level prairie extending from Coeur d'Alene, Idaho, to Spokane, Wash., a distance of 34 miles, and for some miles west of Spokane, and is 3 to 8 miles wide. This is closely backed on either side by timbered foothills covered with evergreens. The irrigated and irrigable lands of this valley lie at an elevation of about 2,000 feet.

The soil is composed of a rich black volcanic ash, mixed with small gravel. The soil on this prairie is from a few inches to several feet deep and is underlaid with a thick bed of bowlders and gravel. The average rainfall for a long period of years has been 17.91 inches. Previous to irrigating any of this valley most of it had been devoted to wheat, oats, and barley farming, with an occasional small orchard. The weather conditions are best shown by the following table:

*Meteorological data for Spokane, Wash.*

[Compiled from U. S. Weather Bureau reports.]

Year.	Temperature.				Wind. <sup>a</sup>		Rainfall and melted snow.					
	Mean	High- est.	Low- est.	Range.	Direction.	Velocity.	Total.	May.	June.	July.	Season Sept. to June—	
	°F.	°F.	°F.	°F.		Miles.	In.	In.	In.	In.		In.
1895 .....	48.0	95.0	8.0	87.0	SW.	42	13.46	1.58	0.42	0.42	1894-95	12.66
1896 .....	48.6	100.0	-13.0	113.0	SW.	37	20.82	2.29	.73	.17	1895-96	14.78
1897 .....	48.2	100.0	3.0	97.0	SW.	37	23.84	1.05	3.51	.98	1896-97	21.43
1898 .....	48.2	104.0	-2.0	106.0	S.	41	12.60	1.63	1.21	.43	1897-98	18.63
1899 .....	47.2	98.0	-21.0	119.0	S.	36	20.12	1.02	.56	.30	1898-99	13.27
1900 .....	49.8	100.0	-10.0	110.0	SW.	48	18.72	2.12	.42	.34	1899-1900	17.38
1901 .....	48.9	99.0	10.0	89.0	S.	38	15.99	1.26	1.05	.61	1900-1901	18.81
1902 .....	47.9	94.0	-12.0	106.0	SW.	52	19.23	1.83	.45	1.71	1901-2	15.79
1903 .....	47.5	97.0	4.0	93.0	S.	40	16.55	1.34	1.35	1.13	1902-3	13.96
1904 .....	49.9	100.0	7.0	93.1	S.	40	14.15	.13	1.42	.34	1903-4	16.83
1905 .....	48.2	103.0	-7.0	110.0	NE.	40	16.68	1.98	4.16	.06	1904-5	14.64
1906 .....	49.4	99.0	7.0	92.2	SW.	36	17.60	3.42	1.02	.02	1905-6	14.77
Average.....	48.5	.....	.....	102.3	SW.	41	17.50	1.64	1.34	.54	.....	15.90

Year.	Number of days—							Frost.			
	Clear.	Partly cloudy.	Cloudy.	Rain- fall greater than 0.01 inch.	Above 90° F.	Be- low 32° F.	Be- low zero.	First.		Last.	
								Light.	Killing.	Killing.	Light.
1895 .....	81	126	158	98	8	121	0	Sept. 6	.....	.....	June 14
1896 .....	97	99	170	118	22	92	1	Sept. 16	Oct. 27	Apr. 20	May 27
1897 .....	118	69	178	134	17	119	0	Sept. 9	Oct. 3	Apr. 12	Apr. 27
1898 .....	131	97	137	101	21	119	1	Oct. 1	Oct. 5	May 7	May 24
1899 .....	90	112	163	134	8	95	2	Sept. 7	Oct. 14	Mar. 17	May 15
1900 .....	66	86	213	124	12	79	1	Sept. 7	Sept. 26	Apr. 9	June 9
1901 .....	90	109	166	113	14	103	0	Sept. 15	Nov. 2	Apr. 9	June 11
1902 .....	71	87	207	127	8	92	2	Sept. 17	Nov. 5	Mar. 3	June 6
1903 .....	79	86	200	104	9	124	0	Sept. 13	Nov. 10	Mar. 3	May 23
1904 .....	85	87	194	112	27	102	0	Sept. 11	Oct. 28	Apr. 17	June 24
1905 .....	102	78	185	118	17	128	1	Sept. 1	Oct. 9	May 1	May 25
1906 .....	91	91	183	113	25	109	0	Sept. 11	Oct. 21	.....	May 5
Average.	92	94	179	116	16	107	.....	Sept. 12	Oct. 19	Apr. 12	May 28

<sup>a</sup> The average hourly velocity of the wind for the 12 years was 6 miles.

<sup>b</sup> During May, June, and July is the critical period for agriculture.

At present there are several fine irrigated tracts in the valley. Among the more important may be enumerated the lands served by the Spokane Valley Land and Water Company's canal, Hazelwood, Opportunity, Greenacres, Otis Orchards, and east Greenacres. At the present rate of progress it can be only a very short time until this fine valley is all irrigated.

So far practically all of the Spokane Valley that has been watered and that is being sold as irrigated property is recommended and marketed as suitable for orcharding and truck gardening. Some of the old orchards that failed to produce a marketable crop under dry farming are now yielding good profits. Frequently berries are planted between the young orchard trees, and truck gardening, either between the orchard rows or otherwise, yields good returns.

This valley is crossed by the Spokane and International Railway, by the main line and a branch of the Northern Pacific Railway, and by the Coeur d'Alene electric line.

#### IRRIGATION AT PEACH.

Where Hawk Creek empties into the Columbia River, a few miles below the mouth of the Spokane River, there is the little town of Peach, which takes its name from the fruit raised there. About 400 acres are watered from Hawk Creek, most of the land being devoted to the raising of peaches. Near here, from the mouth of the Spokane River down to Peach, are several hundred acres that could be irrigated by pumping. A plant is contemplated 9 miles above Peach to water 200 acres.

#### SPOKANE VALLEY LAND AND WATER COMPANY.

At Post Falls, Idaho, this company diverts 250 cubic feet of water per second and distributes it through an exceptionally well-built canal. Between Post Falls, Idaho, and Spokane there are about 12,000 acres that can be watered successfully from this canal. The soil is a rich black, gravelly loam. Much of the land under this system is held by individuals. As the land is practically level and smooth and as the company builds and maintains the laterals to each tract of land sold, the expense to the settler is only for breaking and smoothing the land. Since most of these lands were formerly cultivated in grain crops the cost would hardly exceed \$5 to \$10 per acre. Places that are stony will cost more. The average annual precipitation is about 18 inches and the elevation 2,000 to 3,000 feet.

In 1905, 313 acres of vegetables at Greenacres received 343 acre-feet of water, or the equivalent of 13.2 inches of rainfall. Water was applied only during July, August, and up to September 15. Forty acres of alfalfa were watered to the amount of 4.1 acre-inches per acre. One hundred and thirty acres of general crops, including orchard, with alfalfa, vegetables, berries, melons, and other crops between the rows, and some corn, received water at the rate of 15 inches over the entire surface. This was exceptional. In 1904 the vegetables received about 24 acre-inches per acre and corn 17 acre-inches. The irrigating season depends upon rains, and commenced nearly fifty days earlier in 1904 than in 1905.

Lands under the Post Falls diversion may receive water to the depth of 21.5 inches. The Greenacre tract, owned by the same company and supplied from Liberty Lake, has an allowance of 1.25 acre-feet per acre. The Fish Lake district in Idaho, consisting of about 3,000 acres, receives the same amount.

## HAZELWOOD IRRIGATED FARMS.

The property known as Hazelwood Irrigated Farms is a little plateau or bench of gently rolling prairie, at an elevation of 2,200 to 2,300 feet, and covering not to exceed 2,500 acres. It lies on the west and comes up to within 4 miles of the city of Spokane. The water supply is lifted by an electrically-driven 15-inch centrifugal pump from Silver Lake, a body of clear, potable water about 3.5 miles long and 0.5 mile wide, covering approximately 700 acres. This pump, operating against a lift of 60 feet, discharges 8,660 gallons per minute through a 36-inch wood stave pipe into a small basin, from which it is carried to the edge of the property in an open ditch. The distributing system is largely of machine-banded wood stave pipes, through which the water is delivered to the high point of each 10-acre subdivision. The contracts agree to supply water at the rate of 1 cubic foot per second for each 200 acres of land. If, at this rate, the water was used four months, it would supply  $1\frac{1}{8}$  acre-feet of water per acre. The water is measured to the settler over a weir on his land and is supplied by the rotation method, so that he has always a good head of water with which to work. Two thousand acres of this land has already been sold and water is being delivered.

Maintenance charges are \$2.50 per acre per year, which is estimated to be the actual cost of the service. The deeds provide that at such time as the water users are the landowners, the Hazelwood Irrigated Farms Company will deed over to the landowners the entire plant, but until such time the company guarantees that the maintenance will not exceed \$2.50 per acre-foot of water delivered. This land is being recommended and sold as high-class orchard land. It brings \$250 per acre, with 7 per cent interest on deferred payments.

The soil is a rich, sandy loam, free from gravel, and for many years was cultivated in wheat and oats, yielding good returns without artificial watering. The subsoil is sand and gravel.

## OPPORTUNITY.

Opportunity, reaching to within 3 miles of Spokane on the east, is a part of the territory previously described as the Spokane Valley and is close to Greenacres, from which crop reports have been noted above. The soil is from a few inches to 30 inches deep and is underlaid with coarse gravel. Opportunity comprises about 3,000 acres and is watered from wells ranging from 90 to 120 feet deep. Water is lifted by turbine pumps direct-connected to electric motors, all installed in the bottoms of the wells. The power is supplied by the Washington Water Power Company. In addition to the water pumped for irrigating, there is a separate pressure system for do-



mestic use and 48-candlepower electric lights, the latter going with each 10-acre tract. Ninety per cent of these lands have been sold already. The balance are on the market at \$350 to \$400 per acre.

#### OTIS ORCHARDS.

The holdings of the Spokane Canal Company are located 12 miles east of Spokane, on the north side of the river. This tract is watered from Newman Lake, which covers an area of about 1,100 acres, and the project is designed to cover 4,000 acres, of which about 3,000 acres is now watered; 850 acres is yet for sale at \$350 per acre.

#### ARCADIA.

North of Spokane about 14 miles, on the line of the Spokane Falls and Northern Railway, is Arcadia. The canals supplying this tract cover several sections of timbered land, which, in the main, has been logged and which the company is now clearing and planting to orchards. The water supply is from Dragoon Creek, and is to be supplemented by storage. The soil is a light, friable, sandy loam of good depth and is underlaid with gravel. The altitude is 2,100 feet.

#### LOWLANDS ALONG THE COLUMBIA.

The country bordering on the east of Benton County and adjacent is low, somewhat triangular in shape, with the slender apex of the triangle near Wallula and the broad end opposite White Bluffs. This strip of low sagebrush desert is about 55 miles long and 15 miles wide in the widest part. Most of this large tract of land is less than 100 feet above the Columbia River and can be reached by stored water from the Yakima River. The land may be classed as sandy and sandy loam, and unquestionably is a lake deposit. The lands in the neighborhood of Richland, Kennewick, and on south along the west bank of the Columbia are already irrigated with water from the lower Yakima River. The season on this division is extremely early. The first strawberries on the market come from Kennewick, located on this tract. The dates and temperatures of the last killing frosts for the past three years are as follows: 1908, April 30, 28° F.; 1907, April 18, 29° F.; and 1906, April 12, 28° F. The first severe frost in the fall comes in November.

For peaches and early berries, located on lowlands in the cold-air drainage, smudging is sometimes resorted to. The uplands are warmer. The season rainfall is 7.46 inches, nearly all of which comes in winter. The long, hot summers have a cloudless sky.



## KIONA DITCH.

At Kiona some small tracts are watered from a ditch taken out from the left bank of the Yakima River 4 miles above Kiona. Also, a few small holdings are watered with wheels operating in a small canal.

## KENNEWICK CANAL.

The Kennewick Canal was constructed by the Northern Pacific Irrigation Company, a Washington corporation, but has recently been purchased by other parties, together with some additional land above the Kennewick Canal. The lowlands under this canal lie on the west bank of the Columbia River at a general elevation of 365 feet. The canal covers approximately 11,000 acres, about 6,500 acres of which is now under cultivation. There are yet some 4,500 acres for sale at prices ranging from \$125 per acre upward, depending on location and quality of land. The new company is perfecting plans to lift water from the Kennewick Canal 100 feet onto a fine plateau of 3,000 acres immediately west of Kennewick. One cubic foot per second of water is allowed for each 160 acres of land. The water is measured to the consumer over a weir. The maintenance charge is \$1.50 per acre per year.

## BENTON WATER COMPANY.

The Benton Water Company filed an appropriation for water from the Yakima River for 3,500 acres. The company's contracts call for 1 cubic foot per second for each 160 acres of land. At present, however, everyone takes what he seems to need. About 2,000 acres has been sold and is using water; 1,500 acres is yet for sale at prices ranging from \$100 to \$250 per acre. The maintenance charge is \$1.50 per acre per annum.

## GROSSCUP CANAL.

The Lower Yakima Irrigation Company is placing a diverting dam and enlarging the Grosscup Canal to cover 16,000 acres in what is known as the "Horn," between the Yakima and Columbia Rivers. It has consolidated with the Benton Water Company, whose lands the new ditch will cover. These changes and enlargements will soon put several thousand acres of fruit and grass lands on the market at prices ranging from \$80 to \$400 per acre. The Northern Pacific Railroad supplies transportation for the entire Yakima River Valley.

## WHITE BLUFFS.

At White Bluffs, on the west side of the Columbia River, the White Bluffs Land and Irrigation Company has installed a pumping plant to lift water about 50 feet from the Columbia River onto about 2,500

acres of sagebrush land at an elevation of 450 feet above sea level. The water is distributed under pressure through machine-banded wood stave pipes ranging from 8 to 24 inches in diameter. About 1,500 acres is already under the pipe system. The original installation consisted of two producer gas plants of 100 and 150 horsepower, respectively, supplying gas to two engines of 100 and 150 horsepower, respectively, which in turn were coupled to two vertical centrifugal pumps, one 10-inch pump rated at 3,000 gallons per minute and the other a 12-inch pump rated at 4,500 gallons per minute.

The lands are sandy and underlaid with gravel. The climate is similar to that at Kennewick, Pasco, and Richlands.

The annual maintenance charge is \$2 per acre and the water supplied is 1 cubic foot per second for each 160 acres.

#### HANFORD.

The water used for irrigation for the Hanford lands is pumped from the Columbia River at a point in sec. 6, T. 13 N., R. 26 E., in Benton County, where two pumps, with a combined capacity of 83,000,000 gallons per day, are in successful operation. From this point, and extending in a general southeasterly direction for a distance of approximately 20 miles, a canal has been constructed, with the necessary laterals, to serve the district. About 16,000 acres at a general level of 400 feet is irrigable from the system already constructed. Additions will likely be made to this as sales warrant. These lands are generally level, sloping just enough to irrigate well, and are underlaid with gravel. The soil may be classed as sandy and sandy loam.

The mean annual temperature is about 54° F. The rainfall is light, coming principally in winter and spring. The summers are long, hot, and cloudless.

These lands are being marketed as suitable for fruit raising, timothy, clover, alfalfa, and vegetables. The sale of lands has only just begun. They are on the market at prices ranging from \$90 to \$300 per acre, with a perpetual water right.

The pumps for this system are operated by electric power, which is generated at Priest Rapids, in sec. 2, T. 13 N., R. 23 E., in Yakima County, where a large power plant has been constructed at great expense. The power will be used also for general commercial purposes.

The power canal is 10,275 feet long, with a weir across a narrow channel in the river which connects it with an island, making in effect a wing dam about 3,000 feet long. The canal below the weir for a distance of 7,000 feet follows a natural rock channel having a width at low water averaging 500 feet and at high water 1,000 to 1,200 feet. Below this point it is excavated to a bottom width of 67 feet

and a top width at high-water line of 133 feet. The material taken from this excavation, consisting of earth, gravel, and rock, is placed in the embankment between the canal line and the river. This embankment on the river side is heavily protected with loose rock. A crib weir 450 feet wide built across the canal raises extreme low water in the river about 2 feet, thus increasing the volume entering the canal at low water. This weir is built of timber cribs filled with rocks and is submerged at all stages except at extreme low water. Timber flood gates are built across the canal at a point 4,600 feet below the intake, which provide for shutting water out of the canal at all stages of the river, the water entering the canal being diverted over the river side of the canal when the river is at extreme flood. At other stages the water is held in a bay by the closed gates. The canal bank is held by a timber retaining wall set in bed rock to permit of overflow without damage. There are 11 flood gates, each giving a clear opening 17 feet 2 inches in width and 7 feet in height and allowing the unobstructed passage of 5,000 cubic feet of water per second. This amount can be greatly increased at slight loss of head. These gates are of the horizontal butterfly type, operated at balanced pressure with ease and rapidity.

The power house is built of reenforced concrete complete for two power units and one exciter unit. It is 67.5 by 70 feet and about 90 feet high above foundations. This power house may be extended down stream a distance of 2,200 feet along the gravel bench which would carry the power canal. The turbo-generator unit already installed furnishes power largely in excess of the amount required to operate the pumps. The pumping station is of reenforced concrete, built to accommodate four motors and pumps with lightning arresters and transformers, bilge pumps, and full equipment of instruments. The two synchronous induction motors and pumps already installed and in operation are of the vertical centrifugal type, carrying the motor directly connected to the shaft. The speed of the motors is synchronous with the generator and the column of water pumped is controlled accurately by regulating the speed of the turbines. Their nominal capacity is 64 cubic feet per second each at a speed of 175 revolutions per minute. Their combined capacity is 83,000,000 gallons per day, a sufficient quantity to irrigate 16,000 acres. A discharge pipe 455 feet long conveys the water from the pumps to a concrete basin at the beginning of the irrigation canal. This pipe is 66 inches inside diameter, of wooden staves, banded with round steel rods suitably spaced for the pressures.

The main canal is built a distance of 100,800 feet, or nearly 20 miles, from this discharge basin. It is 8 feet wide on the bottom, 24 feet wide on top, and 5.5 feet deep. The water is conducted from the main canal to the lands through lateral ditches constructed at favor-

able points and through pipe lines where ditches can not be built. The entire plant of this company shows good workmanship and stability.

#### MOORE PROJECT.

Just above Pasco, on the Columbia River, James A. Moore is preparing to water 1,000 acres of fine land. The plant will consist of a 100-horsepower installation working against a lift of 45 feet. This is one of the largest of the many small plants along the Columbia River. There are very many gas-engine plants ranging from 5 horsepower up, and lifting water from a few feet to 90 feet, located along the Columbia and pumping onto low-lying strips of land, many of which are planted to fruit trees.

#### DRUMHELDER DEVELOPMENT COMPANY.

At Coolidge, on the lower Columbia, is located the Drumheler Development Company's irrigation project, which is designed to cover 1,600 acres, lying at an elevation of about 200 feet. The water for this system is to be lifted about 50 feet. The power installation consists of a 100-horsepower gas producer and engine operating a single-stage centrifugal pump with a rated capacity of 3,000 gallons per minute. The water is to be delivered under pressure through machine-banded wood-stave pipe to the high point of each lot.

The average temperature for January is 34° F. and for July 73°. The precipitation is extremely light, ranging from 4 to 6 inches. There are approximately 300 days of sunshine. These lands will be cleared and prepared for water before being placed on the market and will then be offered for \$200 per acre and up.

#### PATERSON.

At Paterson, on the lower Columbia, there is another pumping plant consisting of a 250-horsepower producer gas plant driving a three-step centrifugal pump operating against a head of 250 feet. The distribution here will also be through pipes, and 400 acres is watered. When completed the plant is intended to cover 1,800 acres of sandy-loam soil. The weather conditions are about the same as at Coolidge.

#### BLALOCK ISLAND.

On Blalock Island, in the lower Columbia Basin, another producer gas plant is pumping water for about 500 acres of sandy land. This is a 100-horsepower plant operating against a maximum lift of 35 feet. The water is distributed through wood and iron pipes.

At other places along the Columbia River smaller installations have been made, which water in the aggregate a considerable body of land.



## WASHTUCNA VALLEY.

The Washtucna Valley, or coulée, in the Palouse country, is a narrow, flat valley, from one-fourth to three-fourths mile wide and comprises a total of about 4,000 acres of irrigable land. The elevation ranges from 800 to 1,100 feet above sea level, while the lands extending along and adjoining this valley are 100 to 300 feet higher. These uplands are a part of the Washington wheat belt. The water supply is taken from the Palouse River, and is to be supplemented by storage from Rock Lake, a body of water about 9 miles long and one-half to three-fourths mile wide. This valley has a sandy, porous soil, commonly known as "volcanic ash." It yields good crops of alfalfa, and some domestic orchards under small ditches have yielded good returns. A company owns 2,000 acres under canal, which is being planted in tracts of 5 and 15 acres. Much of this land has previously been cultivated, and with a small amount of work can be made ready for water.

The contract allows 1 cubic foot per second for each 140 acres and provides a maintenance charge of \$2 per acre per year. Lands with a perpetual water right are listed at \$100 to \$150 per acre.

The climate is mild, as is shown by the following weather conditions, which are the averages of six years, as taken from the United States weather reports:

	Degrees.
Mean annual temperature-----	54
Coldest month (January)—average-----	36
Warmest month (July)—average-----	90
Forty-four days in the year the maximum exceeds-----	90
Maximum temperature -----	108

## PRECIPITATION.

	Inches.
Annual -----	13. 73
July and August—average-----	. 67
March to May—average-----	1. 60

Average wind movements are 4.5 miles per hour.

## PASCO POWER AND WATER COMPANY.

The Pasco Power and Water Company, a few miles above the mouth of Snake River, is installing a pumping plant to water about 12,000 acres of sandy land in the vicinity of Pasco, more than 6,000 acres of which is owned by the company. The installation at present consists of a cycloidal rotary pump working against an 85-foot head and driven by a water turbine operating under a 9-foot head. This is commonly known as the Two Rivers project. Lands are offered at \$200 per acre with a water right. The sagebrush is small and the cost of clearing generally low.

## SNAKE RIVER VALLEY.

The elevation of Snake River from its mouth, through the southern part of the State to Idaho, varies from 350 to 750 feet. Frequently along its course are to be found bars and low benches, under a high state of cultivation, planted either to orchards or vegetables. The water to irrigate these tracts is either pumped or taken from small creeks and springs discharging into the Snake River. The total of such private holdings amounts to about 1,200 acres.

The La Follett orchard at Wawawai, consisting of 325 acres, gets most of the water needed from Wawawai Creek, and supplements by pumping from Snake River. The soil on the higher lands is a loam; on the bars it is sandy.

## LEWISTON-CLARKSTON COMPANY.

The Lewiston-Clarkston Company utilizes the water of Asotin Creek for power and irrigation purposes. It waters about 8,000 acres in and about Clarkston, near the confluence of the Snake and Clearwater rivers. The water for these lands and for power is carried from Asotin Creek in a 48-inch steel-banded wood stave pipe to the power house, from which a 40-inch pipe carries it to the point of diversion for the two benches. A 32-inch pipe serves the lower bench, and after delivering the water to a power plant the waste is collected in a reservoir for use in irrigating the lower levels. These lands lie generally in two benches, and range from 750 to 1,250 feet in elevation. The water service is entirely through pipes, and is measured to the consumer through a disk meter.

The soil of the upper bench and the north slopes is a deep rich loam. South slopes carry some gravel with the loam. The lower bench, most of which is now in bearing orchards, is a sandy loam.

Transportation facilities consist of two railroads and a steamboat line. The upper bench of 5,000 acres has only recently come into the market. Lands here are offered at \$275 per acre, with a perpetual water right.

The mean annual temperature is 53.2° F; the average for January 35.9°; the average for July 73.6°; the average latest killing frost in spring is April 9; the average date of earliest killing frost in fall is November 4. Any damage by late spring frosts is minimized by smudging. The average annual rainfall for the past seven years has been 13.83 inches, most of which came from November to April.

This tract is devoted almost exclusively to fruit growing—apples, peaches, pears, apricots, plums, cherries, grapes, and berries. All kinds of vegetables suited to such a climate produce abundantly. The maintenance charges are \$2.50 to \$4 per acre per year, depending

upon the cost of operating the plants and distributing the water. The company's contracts provide for 1 acre-foot of water for each acre for the irrigated lands.

When the lands are all sold, the rights, titles, and obligations of the company are to be turned over to the settlers, and the works are to be maintained and operated by them.

#### WALLA WALLA VALLEY.

In general, it may be said that all lands about Walla Walla accessible to the small streams and springs, where there is sufficient water, are being irrigated now. These lands have raised good grain crops without artificial watering, but with irrigation many of them have been converted into gardens, berry patches, and orchards. Some of the finest orchards in the State are along the Touchet River. Formerly they were not watered, but water was later diverted for them and now, under irrigation, they are yielding very attractive profits.

Space will permit the mention of only a few of the more important private enterprises in the Walla Walla and Touchet River valleys. Only the larger ones have lands for sale.

#### WALLA WALLA IRRIGATION COMPANY.

The Walla Walla Irrigation Company operates the Burlingame Ditch, which takes water from the Walla Walla River for about 1,500 acres of land, 1,000 of which is now under cultivation. These are loam soils quite similar to the wheat lands adjoining them. The climate is moderate; the mean temperature, 53° F. The average latest killing frost in spring is April 6; the earliest in fall is November 1. The annual rainfall is about 8 inches.

Considerable land under this enterprise is on the market at \$150 per acre. The crops most raised in the Walla Walla Valley are alfalfa, fruit, and truck. Frequently four crops of alfalfa are cut from the irrigated lands per year. The uplands are one great wheat field.

#### COLUMBIA CANAL COMPANY.

The Columbia Canal Company is now marketing lands and selling water rights on a tract of land lying at the junction of the Oregon Railway and Navigation and the Northern Pacific Railway companies' lines near the town of Attalia. The canal heads in the Walla Walla River and follows the Walla Walla Valley from the head-works to Wallula, covering several hundred acres of private lands that will soon want water rights. It then turns north along the eastern border of the Columbia. The project now covers about 5,000

acres and may later be extended to reach about 3,000 more. The head-works, canal, and flumes are generally well built. A storage reservoir to impound 5,000 acre-feet of water is contemplated in connection with the project.

The water supply is being augmented further by the installation of a 100-horsepower gas engine and a 10-inch horizontal centrifugal pump discharging through a 20-inch machine-banded wood stave pipe under a 28-foot lift. The maximum capacity of the plant was given as 10 cubic feet per second. The lands along the Columbia are sandy, while those along the Walla Walla Valley are much heavier and carry only a small amount of sand. About one-tenth of the lands have been sold, the price now being \$300 per acre. The small orchards looked well in August. The trees and grapevines showed thrifty growth. The third crop of alfalfa was being cut August 11, 1908. The season is early, the lands lying at 350 feet above sea level.

The contract provides for 1 cubic foot per second for 160 acres, to be delivered between April 5 and October 15 of each year, and a maintenance charge of \$2 per acre. There is a further provision which stipulates that—

It is further understood and hereby agreed that when the company shall have sold all its lands and all water rights therefor it shall have the option to transfer and turn over to the owners of said lands and water rights \* \* \* all of its rights, titles, and interest in and to its irrigation works, etc., and thereupon the company shall be absolutely absolved and relieved from the obligations imposed by the contract. \* \* \*

#### HAWLEY DITCH.

The Hawley Ditch heads in the Touchet River, which has its source in the Blue Mountains. The ditch covers 1,000 acres of land quite similar to that under the Burlingame Ditch, being located only a short distance away; 500 acres of this tract is already under cultivation.

#### RADER DITCH.

The Rader Ditch is intended to water about 600 acres all summer and 500 acres more during the winter and spring. This tract is devoted largely to alfalfa raising and yields a good revenue.

#### J. L. DUMAS ORCHARD.

The J. L. Dumas orchard, near Dayton, on the Touchet River, consists of 100 acres of irrigated apple orchard, the gross receipts from which in 1907 were \$50,247. Near by are several other smaller orchards yielding good returns. The Dumas orchard is planted to choice varieties of winter apples.



The Blalock Fruit Company pipe the sewage from the city of Walla Walla, a city of 20,000 population, to their orchards and vegetable and alfalfa lands. This is supplemented by two artesian wells and some water taken from Mill Creek. Five hundred acres is in orchard and alfalfa and 400 acres in alfalfa and vegetables.

Practically all the water of the Walla Walla River during the low season is appropriated for power or irrigation purposes. Winter and spring irrigation with the flood waters has given good return in the valley.

### METHOD OF DISTRIBUTING WATER.

The method of distributing water to land is about the same throughout the State. It consists of taking water from the main channels by laterals which carry it to the farms, where it is picked up by head ditches or flumes, from which are provided small openings about every 3 feet, which in turn discharge the water into rills or corrugations. The head ditches should not be farther apart than 20 rods. The purpose is to get an even and rapid distribution of the water and a cultivation shortly afterwards, so that the soil may retain the moisture and its warmth.

### COST OF CLEARING LAND.

The cost of clearing land of sagebrush, leveling, ditching, fluming, and making ready for seeding or planting, will range from \$6 to \$35 per acre, depending on the size and density of the sagebrush and the roughness of the land, cost of flumes, ditches, and other factors. When the soil has been blown and drifted until it is all in hummocks and hollows, the cost will be high. In any event, the work should be well done at the start; it will save vexations and costs later. There is usually so much variation in such costs on any particular tract that it was thought best not to undertake to give that item in connection with the discussion of the several tracts. A few reports of actual expenses in preparing land may be of interest:

J. E. Frost, of Ellensburg, reported the cost of clearing 340 acres to be about \$5 per acre. This did not include ditching, flumes, or seeding.

R. K. Tiffany gives the cost per acre of preparing and seeding some of his land as follows:

Clearing and burning brush.....	\$5. 00
Leveling, building head ditches, seeding, and watering the first time.....	15. 00
Alfalfa seed .....	2. 40
Wheat (nurse crop).....	. 45
Lumber for head ditches and lath for repairs.....	2. 00
Total .....	24. 85

Neill Campbell reported \$13.50 per acre, exclusive of laterals, head ditching, and seeding.

Arthur Bellivean reported the cost of clearing 40 acres and planting it to potatoes as follows:

Grubbing, raking, and burning sagebrush-----	\$100. 00
Plowing, at \$2 per acre-----	80. 00
Scraping -----	24. 00
Leveling, one man and two teams, 8 days, at \$5 per day---	40. 00
Planting, three men, one team, 16 days, at \$5 per day----	80. 00
Seed, 17 tons, at \$6 per ton-----	102. 00
Ditching, one man and one horse, 8 days, at \$2-----	16. 00
<hr/>	
Total-----	442. 00
Average cost per acre-----	11. 05

John Michels reported the average cost per acre on some Yakima Indian Reservation land as \$31.50. The above reports were for 1904, at which time the general level of prices for labor was lower than at present.

The following was prepared by Mr. Walter M. Granger and given as a general average under the Sunnyside Canal:

Grubbing sagebrush, per acre-----	\$2. 50
Plowing -----	2. 50
Leveling -----	10. 00
Ditching -----	5. 00
<hr/>	
Total per acre-----	20. 00

## CAPITAL NEEDED FOR A SUCCESSFUL START IN THE IRRIGATED DISTRICTS OF WASHINGTON.

Taking into consideration the present price of land and the time required to obtain results from permanent crops, the average settler should not undertake to establish a home in an irrigated country with less than \$2,000. In addition to the money required for the "down payment" on land purchased, a settler requires his house and out-houses, a team, wagon and harness, plows, scraper, and other farming implements, depending somewhat on the variety of crops to be raised. The returns from the first year's crop are usually unsatisfactory and can not be depended upon generally to be of much use in defraying living expenses. Some men starting with almost nothing make a success of it. These, however, are the exception. The average settler with little or no money must suffer many hardships and in the end is likely to fail.

At present there are more than 450,000 acres under ditch, of which something over 260,000 acres are under cultivation and are using water. This estimate of lands now irrigated is likely to be too low, owing to the very many small farms taking water from small creeks, springs, and

wells; the acreage so served can be estimated only roughly. In addition to the above there are about 390,000 acres the plans for the watering of which are pretty well worked out or upon which work has been done already. Federal projects cover 327,000 acres of the latter, either as extensions to existing systems or new work in contemplation and reported on, the water for all of which is to be provided from storage reservoirs. Besides this there are other lands in the Big Bend country—about 100,000 acres near Pasco—that could be watered from the Palouse River if suitable and economical storage could be secured. There is quite a tract along the east bank of the Columbia River upon which water could be pumped, power being developed at the rapids above. Even now a company has been formed to divert the waters of the Klickitat for the purpose of irrigating a fine, rich body of land lying between the lower Yakima River and the Columbia. The air is full of projects and no doubt future developments in irrigation will be very rapid.

As has been stated elsewhere, the first lands were irrigated by individuals, who also installed many of the pumping plants. Next came small cooperative companies, which built some very good ditches along the smaller streams and creeks. When the more difficult projects were undertaken, capital was interested and stock companies formed. Later, Federal authorities entered the State and proceeded to make available the storage capacity of lakes for the impounding of water for irrigation purposes.

### WHAT CONSTITUTES GOOD IRRIGABLE LAND.

The soil should absorb water readily and still be able to retain a large application in the upper 3 or 4 feet. A heavy clay loam soil absorbs water too slowly, becomes puddled, and bakes if water is kept on too long, is cold and retains so much capillary moisture that air will be excluded, thus very seriously retarding bacterial action and the liberation of plant food. Such soils require careful handling to secure good results. Vegetation grows slowly upon them, hence they are adapted to slower-growing crops, such as wheat, oats, barley, and hay. On the other hand, many soils are so coarse and sandy that water runs through them as through a sieve. It is difficult to distribute the water over such soils; careless application or the application of too large quantities is likely to wash the soluble plant food through the soil, to be lost in the underdrainage; and, furthermore, they retain so little capillary moisture that they dry out quickly. Between these types we find the happy medium, loam, which has the following desirable characteristics:

(1) It absorbs water readily, yet slowly enough to allow it to be well distributed.

- (2) It retains a large store of moisture by capillary attraction.
- (3) It drains well without leaching.
- (4) Water moves rapidly in any direction through it by capillarity, so that the moisture is kept quite evenly distributed throughout the soil.
- (5) It preserves just about the proper balance between the air and the moisture in the soil.

Loams are the best general-purpose soils and are kept in the best condition for successful plant production at a minimum of expense. Light loams are warmest and will mature crops quickest, hence are preferable where earliness is an important consideration. Heavy loams produce slower growth, but with other conditions equal will produce heavier yields; hence they are preferable where yield is of first importance, provided the crop is not unsuited to the heavier soil. The surface should slope some to facilitate drainage and the subsoil should be open and porous to carry off any surplus water and to protect against the raising of alkali.

### **WATER APPROPRIATIONS.**

In this State by statute anyone may post a notice of the intended use of the water or any part thereof of any stream or lake, but within ten days he must file a copy of the notice with the auditor of the county. It is to be noticed that the claimant is not limited as to the amount he may file on, nor is there any way provided whereby he may know the amount of the legal claims already existing against the same stream or lake. True, he might secure an abstract of filings from the auditor, but as no use has ever been made of many of the claims and as very many of them are far in excess of the entire flow of the stream or capacity of the lake, the honest appropriator can only go ahead and take his chance with the others, remembering that the first in time is the first in right. On many small streams, where the water is all in use for irrigation, the conflicting claims have been adjudicated and each man's rights are covered by a decree. In such instances a grantor may give a guaranteed title to a water right for the land. In other instances, where there are many claimants to a limited supply of water, it will be impossible to be sure of a water-right title until the claimants have had their rights settled judicially. A purchaser would not buy lands with so clouded a title, and since a water right is of the very greatest importance in the purchase of irrigated lands, it is very desirable that the title to water right should be unclouded.

### **PERPETUAL WATER RIGHTS.**

A water right has been defined as a legal right to the use of water. The supreme court of Colorado has defined a water right, acquired



through the use of water carried by an irrigation company, as a right to have a certain quantity of water flow through the irrigation company's ditch as an easement in the ditch. It is a right that attaches to the realty.

To a settler buying irrigated lands where the water supply is very abundant, the water right to his holdings will likely never be called into question; but along small streams and large ones where there are many more lands than can be supplied, his title to water is always open to dispute, and in the end in all probability will be called into court for a judicial defining of the rights.

Companies which sell lands and water rights should establish as safe and unclouded a title to the water rights as to the land to be irrigated. In general, buyers give little or no attention to the title to the water right sold to them. In some instances the deed may convey a right to have a definite amount of water flow through the company's ditches for the land purchased; the company may have filed on a specific amount of water and yet, when the individuals and companies who are first in use and therefore first in right have satisfied their claims, there may be no water for the settler who has purchased under a later appropriation. It is not sufficient that the vendor guarantees a perpetual water right. The right to the use of water comes from the State, and in the first instance the State should not grant a use to more water than can be safely relied upon; and, secondly, the State should not permit individuals to perpetrate a fraud upon innocent purchasers; thirdly, since water is of the essence of the contract, the individual or company selling lands should be required to have their water-right titles defined before making a legal conveyance of the same; and fourthly, until the State shall take official action providing for the safety of such titles, the purchaser should scrutinize very sharply all conveyances that give a right to the use of water and in that study call upon his attorney to examine and recommend the title.

In some instances promoters particularly advertise the amount of water filed upon, when, if the actual unused amount flowing in the stream were really known, there would only be sufficient to furnish a fraction of the amounts claimed. This is doubly true where, with the purchase of lands, the settler purchases stock in the company. In such cases, and they are pretty frequent, when the lands are sold the original promoters are out of it and the settler has no recourse except as against the company of which he himself is a part.

## MAINTENANCE.

It may be well also for a purchaser of irrigated lands to examine closely into the cost of maintenance. This item, in a gravity supply, will depend quite largely on the strength and permanency of the headworks, of the canal banks, and of the structures. Where the supply is pumped, a further study should be made of the power charges. The farmer should know about how many acre-feet of water will be needed for his lands and how much it will cost him, when he becomes a stockholder in the company, to pump the required amount of water onto his lands. Where power is purchased the current price of such power should be made a basis for estimating cost. If the power is developed by steam, gasoline, or producer gas, all items of expense such as fuel, waste, oil, labor, depreciation on plant, and interest on investment and capital should be considered in making up an estimate of maintenance charges.

## DUTY OF WATER.

The settler wants to know not only how much water per acre of land he is to get, but he wants to know if that is enough and at what season of the year it is to be supplied. In some instances the amount of water provided for in the contract seems inadequate or at least the amount stipulated seems to be based on insufficient data as to the requirements of the land for full crop production.

The months in which water is to be supplied is very important. The water in some of the streams of the State is entirely covered by court decrees and in some instances the more recently constructed canals are entitled only to winter and any excess flood waters. On suitable lands such a water supply may be sufficient to raise grass and crops that mature early.

The prospective buyer not only wants a complete title to a water right for his land, but he wants to know that there is ample water to satisfy that claim and at the season of the year that it will be needed to mature crops. This should require an official certificate of the flow of the stream and of the legal claims filed against it.

## SUBJECTS NEEDING TO BE INVESTIGATED IN THEIR APPLICATION IN WASHINGTON PRACTICE.

There is a pressing desire among the farmers to know how much land a given amount of water will irrigate successfully under existing practice; how much is required for specific crops; how far will late fall and winter irrigation help out where the summer supply of water is short; what kind of crops are best suited to the lands receiving a

short water supply or none after June 1; do seepage waters get back into natural channels to materially increase the flow of the stream in its lower reaches; systems of measurements as decreed by the courts and as found in practice should be calibrated and reduced to a rational basis; can one man turn waste water onto another man's land; what are the best methods of conserving moisture; what are the methods of distributing water or spreading it over the fields so as to get the greatest revenue out of a given water supply; should duty be measured at the intake or at the margin of the field; what will it cost to line a canal and distribute water through flumes or closed conduits; will it pay to put so much cost into a distributing system; what is the best practice in cleaning and seeding.

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